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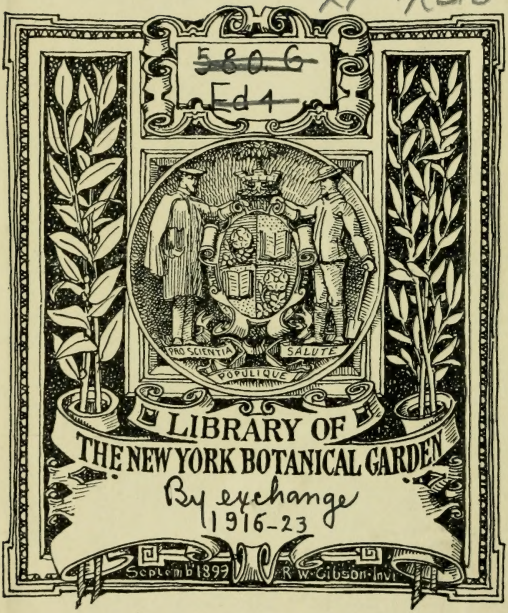

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TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

VOLUME XXVII.

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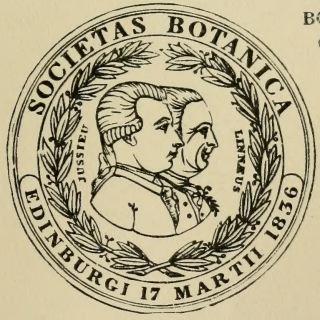

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1919.

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OF THE

BOTANICAL SOCIETY OF EDINBURGH.

VOLUME XXVII.

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SESSION 1915–16.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY BY
NEILL & CO., LIMITED.

And to be obtained from the SECRETARY OF THE SOCIETY, *at the Royal Botanic Garden.*

1916.

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TRANSACTIONS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXX.

Some Plant Associations of N.W. Yunnan.

By F. Kingdon Ward, B.A., F.R.G.S.

(Read 10th February 1916.)

Examination of the flora of any region shows that the plant formations fall naturally into two main groups: the first dependent on the general climate of the region as determined by its latitude and surrounding physiographical features, the climate being described as arctic, continental, temperate, maritime, monsoon, equatorial, desert, and so on; the second determined by local and varying conditions, such as shelter, altitude, rate of change of temperature, or water—factors which modify and in extreme cases mask the regional climate and its effects, while differences of soil introduce a selective element, altering, with the aid of mechanical causes, the plant associations. To the former may be given the name of *dominant formations*, while the latter, which are in the nature of the case numerous in any given region, may be distinguished as *incidental formations*, or *associations*. It will, however, be readily recognised, if this distinction is made, that the terms are relative. A formation such as forest may be dominant in one region—for instance, round the equatorial belt and over a large part of the monsoon area—and incidental in another, as where it fringes a watercourse in arid country; and in Europe the original dominant formations, if temperate—as opposed to coniferous—forest, or grassland (meadow), have often been so much interfered with by man as to be obscured.

In highly mountainous regions it is often very difficult to decide what is the dominant formation, or, more accurately, to what single climatic formation the bewildering series of small plant associations may be assigned. It is only in the foot-hills that a mountain flora betrays not its origin, which may be and generally is another matter, but the dominant climatic formation in the midst of which it is, as it were, a vast incident, or accident On the other hand, when we come to consider a mountainous country the size of Tibet, we are no longer justified in speaking of an incidental formation in the midst of a dominant—the incidental has become the dominant. Here physiographical conditions, altitude and the trend of the mountains themselves, prevail, isolating a specialised climatic area which bears no resemblance to surrounding climates; and here we find a new dominant formation with its own series of incidental formations and plant associations. When, however, we are dealing, not with a great elevated plateau like Tibet, but with a high mountain range or series of ranges traversing two or more climatic zones, the question is more difficult, owing to the dovetailing of one flora into another, with perhaps the introduction of a third flora which has found its way along the range in some former period. In the circumstances it is best to consider the flora of the mountain range by itself, apart from the region in which it is situated; decide which is the dominant formation by reference to the climate; and resolve the incidental formations from it.

The state of affairs alluded to is well illustrated on the Yunnan-Tibet frontier, to a consideration of which this paper is specially devoted, and I shall confine my remarks chiefly to the flora of the Mekong-Salween and Mekong-Yangtze divides, two great parallel mountain chains separated by the deep and narrow Mekong valley. The interest of this region—apart from the jumble of climates: arid, monsoon, temperate, arctic, which succeed one another rapidly in a vertical direction—lies in the fact that it is the meeting-ground for several streams of vegetation. There is, for instance, the Himalayan flora, which has certainly travelled far eastwards into China and southwards into Burma; the Chinese flora, which has also flowed

southwards into Burma; and the Indo-Malay flora which has travelled northwards into the Burmese hinterland and into China, mingling with the descending stream. Naturally, to distinguish and disentangle these conflicting streams of vegetation over so large and diversified an area where several floral regions (*i.e.* regions characterised by endemic species) meet is a difficult matter, with all the fascination of hunting and tracking. This paper, however, has but an indirect bearing on the larger question of origins. The monsoon climate extends, in modified form, as far east as the Salween valley, beyond which everything—fauna, flora, people—changes. Up to a certain point, however, about latitude 28° N.[1] the Mekong-Salween divide too receives a copious summer rainfall from the west, and is covered with mixed forest and dense undergrowth, including many giant herbs. This may be called temperate or mixed rain forest, and it is the dominant formation along the entire length of the range from latitude 28° southwards.

The Mekong-Salween divide, however, to a great extent masks the Mekong-Yangtze divide, acting as a rain screen, so that the latter range, though only a few miles to the east, receives a reduced rainfall, and the dominant formation is no longer rain forest, but coniferous forest and scrub, chiefly oak.

Above the mixed rain forest of the Mekong-Salween divide come several specialised incidental formations, of which the most important are (*a*) *Abies* forest, chiefly confined to the sheer valley walls, well above the stream, but in places disputing the lower ground with (*b*) bamboo brake. Though disappearing from the valley bottoms sooner than *Salix* or *Betula*—which towards the tree limit are much flattened out and stunted by wind,—this *Abies* grows on the precipices, protected from wind, at yet higher altitudes. Where the valley is broad and flat, its floor is occupied chiefly by (*c*) alpine meadow, a growth of tall herbaceous plants with conspicuous flowers, scattered amongst which are alder and birch trees, or in some places

[1] North of this point coniferous forest with a scanty undergrowth predominates, and the flora of the Mekong-Salween divide resembles that of the Mekong-Yangtze divide both in its nature and actual species.

stunted willows. Similar meadows occur in the Tyrol. This meadow occupies all the more level ground, bamboo brake and *Abies* only coming in where the valley narrows and steepens. The gullies, however, which have shot out steep isosceles-triangle-shaped cones of detritus, the broad fan-like base of big boulders tapering more and more steeply up to an apex of sand and pebbles, are occupied, not by *Abies* (except at the very bottom) nor by bamboo, but by (*d*) a peculiar shrub and small tree association of their own; in some places the boulder-screes are overgrown with a dense tangle of rhododendron scrub, 6 or 8 feet high, to the exclusion of everything else.

The absence of trees save from the very foot of the boulder screes is probably due to mechanical causes, trees being unable to maintain their existence in face of the avalanches, whether of rock or snow, which descend these gullies. The alpine meadow seeks light and air, growing in pure sand spread out by the torrent over broad flats, probably silted-up rock basins carved out by former glaciers, for the previous extension of which, in the valleys alluded to, there is ample evidence; while bamboo brake thrives only in the damper, darker parts of the valley, where little sunlight penetrates, though it is hard put to it by *Abies*, whose fastness is the cliffs and mountain sides, encroaching into the valley, especially where the boulder-screes debouch broadly.

The following plants may be taken as representative of the alpine meadow:—

Meconopsis pseudo-integrifolia, Prain; *Fritillaria Souliei*, Franch.; *F. Delavayi*, Franch.; *Primula pseudo-sikkimensis*, G. Forrest; *P. Franchetii*, Pax (rare); *Trollius pumilus*, Don, var. *yunnanensis*, Franch.; *Adenophora* spp.; *Aconitum* spp. (both yellow and blue); *Codonopsis* spp. (twining and erect); *Salvia* spp. (yellow and blue); *Geranium* spp.; *Pedicularis* spp.; *Senecio* spp.; *Umbelliferae*.

The alpine meadow extends into the Burmese hinterland, where I found a luxurious growth above the 'Nmai valley in latitude 26° 45′ N., and again at a lower altitude in the neighbourhood of Hpimaw, latitude 26° N.:—

Meconopsis sp.; *Primula* sp.; *Primula Beesiana*,

G. Forrest; *P. helodoxa*, Balf. fil.; *Thalictrum* sp.; *Codonopsis* sp.; *Aconitum* sp. (twiner); *Allium* sp.; *Corydalis* sp.; *Polygonum* sp.; *Senecio* sp.; *Rumex* sp. (7 feet high); and several *Umbelliferae* were prominent constituents. Several species were identical with those found on the Mekong-Salween divide, on the other side of the Salween.

A not less characteristic association of the Mekong-Salween divide is the undergrowth of the temperate rain forest, which includes the following:—

Umbelliferae (giant herbs, up to 7 feet high); *Thalictrum Delavayi*, Franch. (also up to 7 feet high); *Arisaema* (3 species); *Aquilegia* sp.; *Ribes* spp.; *Paris* sp.; *Convallaria* sp.; *Oligobotrya* sp.; *Lilium giganteum*, Wall. (plants 6 to 7 feet high with racemes of 8 to 12 flowers); *Boraginaceae*; *Filices* (nearly all *Polypodiaceae*, though in considerable variety).

Liliaceae—including *L. giganteum*, Wall., and other lilies, several fritillarias, etc.—are not less characteristic of the open forests in the Burmese hinterland above 7000 feet; also *Arisaema*, ferns, *Ribes*, and so on. But here many ground orchids and begonias add a more tropical touch, which is enhanced by epiphytic orchids, many climbing plants, and trees with plank-buttress roots. The very large leaves of the *Arisaema* spp. and *Lilium giganteum* are characteristic of these open forests unencumbered with bush undergrowth.

Comparing now the flora of the Mekong-Salween divide with that of the Mekong-Yangtze divide to the east, we find considerable differences. The Mekong valley itself is very arid, and displays a characteristic association of plants comprising compact low thorny shrubs (*Sophora viciifolia*, Hance, is the commonest; also a *Berberis*) and a number of rock plants, of which a hedgehog-like *Selaginella* is the most conspicuous. In some places a fine juniper tree grows on the rocky banks close to the water's edge. Ascending the Mekong-Salween divide, this formation rapidly growing richer (including now a *Cupressus*; *Daphne calcicola*, W. W. Sm.; *Androsace Bulleyana*, G. Forrest; *Amphicome arguta*, Lindl.; *Didissandra lanuginosa*, Clarke; and many more species) presently passes

into pine forest, in which oaks, rhododendrons, and other shrubs appear, and this in turn into the temperate rain forest which fills the valleys.

On the Mekong-Yangtze divide, however, this pine forest is wanting; the xerophilous flora of the valley continues to a higher altitude, and then passes into a belt of scrub oak, or in favourable localities a mixed scrub, after which come thin forests of *Abies*, and finally larch. There is no rain forest, and no dense undergrowth, the formation which corresponds to this being a thin open forest with *Picea*, oaks, birches, poplars, and so on, in which shrubs, such as willows, roses, barberry, honeysuckles, etc., actually predominate; and so open is the formation that the undergrowth consists of a few shade plants only, *Podophyllum Emodi*, Wall.; *Pyrola atropurpurea*, Franch.; *Primula lichiangensis*, G. Forrest; *Cypripedium tibeticum*, King; and *Meconopsis Prattii*, Prain, being typical examples where the formation is best developed. In a very few places, by streams, an open grassland appears to a limited extent. *Primula vittata*, Bur. et Franch.; *Androsace spinulifera*, Knuth; *Cynoglossum amabile*, Stapf et Drumm.; and *Trollius pumilus*, Don, var. *yunnanensis*, Franch. are typical plants here. Most of the coniferous trees and a large number of deciduous-leaved trees which are a feature of the Mekong-Salween divide are altogether absent, while, on the other hand, the forest belt is largely made up of a few species: *Picea*, oak, birch, and maple below; *Abies*, juniper, rhododendron, and larch above.

The dominant formation on the Mekong-Yangtze divide then is no longer forest, but shrub (or scrub), which covers the greater part of the range: on the most exposed slopes it is always scrub oak; on more sheltered slopes it is mixed, comprising a number of thorny *Leguminosae* (*Caragana*, etc.), *Berberis*, *Jasminum*, *Rosa*, and others; and in the valleys are willows, *Lonicera*, roses, small trees like *Pyrus* and maple, with scattered meadow plants by the streams, the latter, however, including none of the characteristic plants met with in the alpine meadow of the Mekong-Salween divide. Here trees begin to appear—birch and *Abies*—not, however, forming thick forests. It is evident then that on the Mekong-Yangtze divide forest is

an incidental formation; only in a very few favoured spots does it occur to the exclusion of shrub growth, and then it is usually *Abies*, covering only a small area. The greater part of the divide is covered with shrubs, and a thin belt of trees is found at high altitudes. This great difference is largely due to the difference of rainfall on the two divides, but wind is probably just as important, as the following tables suggest. It should be noted that though the change of climate is sufficient to check tree growth on the Mekong-Yangtze divide, and introduce very considerable differences into the composition of the forest and flora generally, it is not sufficiently great to do away with tree growth altogether. Some of the differences in the composition of the flora too must be ascribed more directly to other causes—for instance, the retreat of the glaciers which has plainly modified the alpine flora, though this is indirectly due to the changed climate, which has caused the retreat. There is, however, good reason to believe, as I hope to show in a future paper, that whatever the differences in the flora of the two mountain chains now, and whatever gulf separates them, they must once have been derived from a common origin.

The following tables were drawn up after taking a series of observations with a small instrument, called an evaporimeter, devised by Sir Francis Darwin. It consists of a small cylindrical copper vessel fitted with a lid, and an elbow-joint carrying a capillary tube gauge of glass, with a scale of millimetres. A small frame, inserted through a slot in the lid, serves to spread a small T-shaped piece of blotting-paper which dips into the water. It was not a very satisfactory instrument, as the evaporating surface was, in humid air, too small to give visible results, while, on the other hand, the capillary tube gauge from which the amount of water evaporated was read off, was apt to get clogged during the fine drizzling rains on the Mekong-Salween divide, and so vitiate the readings. Nevertheless it served to give some indication of the comparative rates of *evaporation* at the selected stations (see tables), though the paucity of records, partly owing to the above-mentioned defects, and partly to causes beyond my control, renders the results only approximate. It must not be forgotten that

I.—*Atuntsu.*

Date.	Temperatures. Max.	Min.	Evaporation.	No. of hours.	Weather Conditions.	Bar.	Altitude.	Average Rate per Hour.
			mm.				feet.	mm.
June 6	67	43	10	7·2	Continuous sunshine; light breeze	20·60	11,500	1·38
„ 7	62·5	42	5	6	Sky overcast; slight drizzle	21·07	„	0·83
„ 8	65·2	38·5	11	5	Continuous sunshine; very light breeze	20·72	„	2·20
„ 9	67·9	43·4	10	7	„ „ light breeze	20·73	„	1·43
„ 11	65·5	49	10	8	Intermittent sunshine; fresh breeze	20·67	„	1·25
„ 19	67·8	54·5	17	7·5	Continuous sunshine; fresh breeze	...	„	2·26
„ 20	69·5	56	5	2	„ „ light breeze	...	„	2·50
„ 21	67	48·5	5	4	Intermittent sunshine; fresh breeze	...	„	1·25
„ 22	71	49·5	3·2	3·5	Continuous sunshine; very light breeze	...	„	0·93
July 8	72	51	3·5	4	„ „ light breeze	...	„	1·37
„ 10	70	52·5	5·5	3	Intermittent sunshine; fresh breeze	...	„	1·83
	Av.	Av.	Total	Total	Average rate per hour			Average
11 days	69·0	49·4	85·2	57·2	1·5 mm.			1·5 pr.hr.

II.—*Mekong Valley.*

June 23	Temp. 76°		4	2	After sunset (7 p.m.–9 p.m.); strong breeze	23·7	7,300	2·0
July 4	„ 80°		3	1·5	Sun down (5.30 p.m.–7 p.m.); strong breeze	..	„	2·0
[„ 4-5	..	71°[1]	10[1]	10[1]	During night (7 p.m.–5.30 a.m.)[1]	...	„	1·0[1]]
„ 5	Temp. 83°		3	1·25	Sunshine (1 p.m.–2.15 p.m.); very strong wind	24·0	„	2·4
	Av. Temp.		Total	Total	Average rate per hour			Average
3 days	79·6		10	4·7	2·1 mm.			2·1 pr.hr.

[1] Not included in the average.

III.—*Doker-la Camp* (*Mekong-Salween Divide*).

June 30	66·5	42	1	2	Intermittent sunshine; fresh breeze	19·96	12,700	0·5
July 1	63	43	4	10	Cloudy; frequent showers	19·96	..	0·4
„ 2	63	43	1	3	Cloudy; drizzling	19·85	„	0·3
					Ka'-gur-pw Camp (*M.-S. Divide*).			
July 19	...	37	10	10	Continuous sunshine; light breeze	18·7	15,136	1·0
„ 20	69	39	4	8	Almost continuous sunshine; no wind	...	„	0·5
„ 22	64	40	Not appreciable	3	Cloudy; no wind	...	„	0·0
	Av.	Av	Total	Total	Average rate per hour			Average
	65·1	40·6	20	36	0·5 mm.			0·5 pr.hr.

Mekong valley . Average hourly rate of evaporation = 2·1
Atuntsu . . „ „ „ 1·5 } Ratio 10 : 7·1 : 2·4
Mekong-Salween divide „ „ „ 0·5

the instrument gives no indication of the rate of *transpiration* of any plant; it only measures the humidity or dryness of the atmosphere, thus corresponding more to a hygrometer.

On examining the tables it will be seen that wind is of more importance than high temperature or sunshine in accelerating evaporation. For example, in Table I the average rate of evaporation for six days, recorded as "light breeze" is 1·63 mm. per hour, and that for four days recorded as "fresh breeze" is 1·64 mm. per hour, though in the former case sunshine is recorded as "continuous" for all six days; in the latter case it is recorded as "intermittent" on three out of the four days. Similarly the average maximum temperature for the six days was 68·7° F., as against only 67·5° for the four days. Again in Table II, July 4–5, the rate of evaporation during the night is significant, as is the rate on June 23 after sunset.

At Doker-la, on the Mekong-Salween divide, the humidity of the atmosphere, owing to the perpetual drizzle, greatly retarded evaporation. The weak points in the tables are of course the small number of observations recorded, the fewness of the stations (though the main ones are dealt with), and the fact that the evaporimeter was not exposed between the same hours each day, nor for the same number of hours. However, the final figures, 10 : 7·1 : 2·4, probably give a fairly correct idea of the comparative rates of evaporation (and hence condition of the atmosphere) at these three places, from which we may infer that wind and rainfall are the most important factors in determining the dominant formation, soil and situation being auxiliary factors, helping to control the incidental formations and select the flora.

We come now to a detailed consideration of the composition of the various formations and plant associations mentioned, and first let us take the temperate rain forest, the dominant formation of the Mekong-Salween divide.

The conifers are *Cunninghamia* (?), *Taxus*, *Picea*, of great size (one I measured was 19 feet in girth, 5 feet from the ground), *Abies*, *Pinus* (2 species), and one I could not identify.

Amongst the deciduous-leaved trees are species of *Pyrus*,

maple, *Tilia*, oak, alder, holly, birch, walnut, and many climbers such as *Clematis* and honeysuckles, *Akebia*, *Actinidia*, *Aristolochia*, shrubs like *Ribes*, *Rubus*, and rhododendron, etc. The undergrowth of this rain forest has already been mentioned, as also the next formation, alpine meadow. Within the limits of the alpine meadow come numerous smaller plant associations dependent on soil, situation, and physical conditions generally, and above the tree limit we come to alpine turf, with dwarf rhododendron. Lastly comes open scree, where a few plants struggle up almost to the snow-line, gradually growing fewer and ultimately disappearing altogether.

Starting then from the Mekong valley, we have in the valley itself a xerophilous flora, then the forest belt, dominant because it is dependent on the climate of this region, hot, wet summers and cold winters with some rain at all seasons; hence it covers the greater part of the range, being absent only where the general climate is subordinated to local climatic conditions, the result of extremes, *e.g.* in the bottom of the Mekong valley, and above 14,000 or 15,000 feet. After the forest belt comes the meadow, incidental because it occurs only to a limited extent in the valleys, dependent on special local conditions, and within the limits of the forest belt; forest is often mixed up with it, and outstrips it. Lastly comes the alpine belt, including scree associations, turf, dwarf rhododendron, and precipice plants, above the limit of trees. Hereabouts the conditions are more diverse than down below, and near the tree limit the plant associations change more rapidly than elsewhere with any change of conditions.

On the Mekong-Yangtze divide we also find three main belts, but the differences, as already pointed out, are striking. The first and dominant formation is the shrub belt, which is a continuation of the xerophilous flora found in the valley. Secondly comes the narrow forest belt, which corresponds more or less to the meadow belt on the Mekong-Salween divide, being confined chiefly to the valleys and having the shrub belt mixed up with it. Alpine meadow, which is dependent on an almost continuous rainfall throughout the vegetative season, and

does not, like the forest, mind wind, is wanting altogether; and the third belt, that of the alpine associations, is much the same as on the Mekong-Salween divide, though not so rich in genera. The differences recorded are not, of course, entirely due to the smaller rainfall on the Mekong-Yangtze divide, considerable modifications having been introduced by the retreat of the glaciers and elevation of the snow-line, as already pointed out. Again, the Mekong-Salween divide is the extreme eastern boundary of the monsoon region, and its climate approaches that of the Burmese hinterland, which has undoubtedly contributed to its flora, while the Mekong-Yangtze divide is cut off from this source of supply by the whole length of the dry Mekong valley; if the latter range ever supported any monsoon plants, they would probably have disappeared before now. Here, however, I am dealing with the formations and plant associations, not with the flora and its origin, which is another matter. While, however, the climatic differences on the two ranges have differentiated the formations and to a considerable extent the flora, this does not obscure the still more remarkable similarity noted, nor conceal the fact that a common origin alone will explain this.[1]

The following lists, of course far from complete, contain the names of certain characteristic plants of each association in the alpine region. Those marked with an asterisk are common to both divides (though it cannot be said for certain that others too are not common), and it is worth noting that the alpine flora of the two divides has a much larger proportion of species in common than the forest or meadow belt, very few species of the latter association being found on the Mekong-Yangtze divide, though many species of both the alpine and meadow belts, of the Mekong-Salween divide, extend southwards and westwards into the Burmese hinterland.

Alpine Turf.

**Primula bella*, Franch.
**Primula brevifolia*, G. Forrest.

[1] North of latitude 28° 30′ the formations and flora on the two divides are identical.

Meconopsis rudis, Prain (Mekong-Yangtze).
Meconopsis Delavayi, Franch. (Mekong-Salween).
Primula albiflos, Ward (Mekong-Salween).
**Primula pulchella*, Franch.
**Phlomis rotata*, Benth.
Lilium lophophorum, Franch. (Mekong-Yangtze).
Saxifraga nigroglandulosa, Engl. et Irmscher. (Mekong-Yangtze).
Primula vernicosa, Ward (Mekong-Salween).

Precipices and Rocks.

**Isopyrum grandiflorum*, Fisch.
**Potentilla pedunculatis*, D. Don.
**Diapensia himalaica*, Hook. f. et Thoms.
**Androsace Chamaejasme*, Host.
Gentiana sino-ornata, Balf. f. (Mekong-Yangtze).
Primula dryadifolia, Franch. (Mekong-Yangtze).
Cassiope palpebrata, W. W. Sm. (Mekong-Salween).
Rhododendron, scarlet species (Mekong-Salween).
Meconopsis integrifolia, Franch. (Mekong-Yangtze).

Heath.

Rhododendron sp., "black" (Mekong-Salween). [*Rhododendron campylogynum*, Franch.?]
**Rhododendron* sp.
**Cassiope fastigiata*, D. Don.
**Pinguicula alpina*, Linn.
**Lloydia tibetica*, Franch., var. *purpurascens*, Franch.
Potentilla fruticosa, Linn. (Mekong-Yangtze).
Juniperus sp. (Mekong-Yangtze).
Rubus sp. (Mekong-Salween).
Primula nivalis, Pallas (Mekong-Yangtze).
**Gentiana*, sp.

Screes and Boulders.

**Meconopsis speciosa*, Prain.
**Saxifraga Delavayi*, Franch.
Saussurea quercifolia, W. W. Sm. (Mekong-Yangtze).
Gentiana Georgii, Diels (Mekong-Yangtze).
**Polygonum Forrestii*, Diels.
**Aconitum Hookeri*, Stapf.

Cremanthodium comptum, W. W. Sm. (Mekong-Yangtze).

Lychnis nigrescens, Edgew. (Mekong-Yangtze).

**Arenaria Delavayi*, Franch.

Cardamine granulifera, Diels (Mekong-Yangtze).

**Gentiana heptaphylla*, Balf. f. et G. Forrest.

Crepis rosularis, Diels (Mekong-Yangtze).

Lactuca Souliei, Franch. (Mekong-Yangtze).

On the Sino-Himalayan Flora. By F. Kingdon Ward, B.A., F.R.G.S.

(Read February 10, 1916.)

This is an attempt to explain in some measure the undoubted and long-recognised relationship existing between the flora—at least the alpine flora—of the Himalayas and that of Western China, a country which is one vast complicated series of mountain ranges, not indeed comparable to the giants of the Himalayas in height, but nevertheless of commanding altitude and even more extensive.

It might be urged that there is nothing remarkable in this similarity of floras, both of them alpine; we would, for example, expect dissimilarity between the alpine floras of the Andes and Ruwenzori, or between those of the New Zealand Alps and Kinabalu, but the Himalayas end, geographically speaking, close to Western China and are doubtless connected more or less closely with the Chinese mountains. But the problem of distribution is not so simple as it appears, and moreover there are other intimately related problems which are scarcely explicable on the assumption that the relationship between the Himalayan and Chinese floras is the natural result of present physiographical conditions. It might be, if these mountain systems were actually in contact to-day; but they are not, as a glance at the map of S.E. Asia will show, being breached along the China-Tibet and China-Burma frontier by a number of parallel ranges cutting right across the main axis of the great Asiatic divide. Even so it is less the interpolation of the mountain ranges than the deep arid valleys between them that prove such a stumbling-

block to the student of distribution, and it is evident that we should not find plants common to the Salween-Irrawaddy, Mekong-Salween, and Mekong-Yangtze divides if the present physical features obtained when the distribution took place. Hence, rather than argue that because the mountain systems are connected (which they are not) therefore the floras are similar, we must recognise that because the floras are related, therefore the mountain systems must once have been in closer connection than they are at present.

So much for the main problem. Once we have unravelled this previous continuity of mountain systems, few direct traces of which are left, we may find other difficulties cleared up also.

A question which many English horticulturists who—thanks largely to the public spirit of Messrs. Veitch of Chelsea, and Bees, Ltd., of Liverpool, and to the French Catholic priests before them—have gained some insight into the almost limitless wealth of flora in Western China, are asking themselves is: Whence comes this unparalleled wealth, which (as the acute Sir Joseph Hooker long ago prophesied it would—a prophecy amply borne out during the last two decades by a dozen collectors) more than rivals that of Sikkim?

A critic of mine in the Gardeners' Chronicle, reviewing a book[1] I wrote, in which attention was drawn to the subject, answered this question apparently to his own satisfaction. I must say I thought the explanation rather lame, and moreover the writer was wrong in his facts. But the real inadequacy of it lay in the fact that he altogether ignored the effects of plant migration and mixing, and it is on this fact that I am myself inclined to lay great stress. Briefly, if we can find a satisfactory explanation for the close relationship existing between the Himalayan and Chinese floras, I believe we shall have gone a long way towards explaining the wealth of the Chinese flora, to account for which secondary factors, such as abundant rainfall and richness of soil, are quite insufficient.

Closely connected with the above is the special question, to which I shall revert later, Why does the genus *Primula*

[1] The Land of the Blue Poppy: Travels of a Naturalist in Eastern Tibet, by F. Kingdon Ward, B.A. (Cambridge University Press, 1913).

(and perhaps others, *e.g. Rhododendron*) receive as it were a special impetus in Western China and appear there in its greatest variety, though showing at the same time in many cases a close relationship with the species of the next most prolific area, namely the Himalayas? This is of course a special case of the general problem to which attention is drawn above.

Finally we may ask, How is it that though China has a flora peculiar to itself characterised by a number of endemic species, and India has quite a different flora characterised by other endemic species, the whole mountainous country from the Himalayas to China shows an unmistakable unity in its flora, and a dissimilarity to the floras of the surrounding regions in the midst of which it lies, though, as we have seen, the mountain area is not really continuous so far as the emigration of plants is concerned? It might appear, from a glance at the map, as though the Andes and the Rocky Mountains should show relationship in their floras, and, the reverse being the case, we suspect that the isthmus joining the Northern and Southern Continents was recently under water, a suspicion confirmed by geologists. Similarly while the Rockies support a flora intimately related to that of the Continent, the Andine flora has nothing to do with that of South America, being more closely associated with the New Zealand alpine flora, from which it is inferred that the Andes have been peopled from outside after the distribution of the continental flora, and are therefore a comparatively recent uplift.

The same argument may be applied in the case of the Himalayas and Western China.

Having interested myself in the problems here propounded during several years' travel in Western China, I set to work to gather any facts which seemed to bear on the problems of distribution; and finding that the geographical features of the country can be largely traced to comparatively recent geological changes, and that changes of climate which must have taken place will all afford valuable evidence, I pondered over these matters too. No doubt a complete understanding of all such contributory factors will be necessary for a solution of the problem on which I have embarked; and to obtain the necessary

knowledge a vast amount of exploration, some portion of which I hope may yet fall to my share, is still necessary. Nevertheless, inadequate as are the facts so far collected, and though much revision, addition, and correction will be needed as knowledge increases, it seems to me that some useful purpose may be served by the following attempted explanation.

I will begin with a brief description of the frontier[1] region and the distribution of plants there according to climate.

Geography and Climate.

A glance at the map of Asia will show that in the region of longitude 98°–99° E. and between the 27th and 30th parallels of latitude several big rivers break through from Tibet and flow for some distance due south, parallel to one another and close together, being separated by high, narrow ranges of mountains. Further east, and again in Upper Burma, the trend of the mountains is the same, the peaks growing lower as we go south; however, we need not for the present concern ourselves with these minor ranges, concentrating our attention on the three principal ones: namely, the Irrawaddy-Salween, Mekong-Salween, and Mekong-Yangtze divides, the first-named being the most westerly. Beyond the Salween-Irrawaddy divide come the mountains of the Burmese hinterland, the valleys between which are filled with monsoon jungle, which also clothes the mountains to at least 8000 feet. The monsoon climate in fact, characterised by hot, wet summers and a dry season of greater or less extent (which becomes also a cold season in the north and at high altitudes), extends a little further east, into the Salween valley itself, where in the gullies, even as far north as latitude 28°, I have found a monsoon flora with such plants as *Asplenium Nidus*, Linn., the banana, *Asclepiadaceae*, numerous epiphytic ferns and orchids, climbing Aroids, etc. When we reach the Mekong-Salween divide we find that great range also clothed with luxuriant forests and meadows, the former lacking many of the characteristic arborescent monsoon genera, but neverthe-

[1] The frontier between Tibet and Yunnan in the north, Burma and Yunnan in the south, spoken of throughout this paper as the Burma-Yunnan area.

less deserving to be called temperate rain forest, but beyond this the monsoon does not extend. South of latitude 28° the Mekong valley is very much drier than the (monsoon) Salween, and even in the gullies supports little monsoon vegetation, so that the two, separated by a high but narrow mountain range, are in strong contrast. Still further east therefore the change, even on the mountains, is pronounced, and the Mekong-Yangtze divide, instead of being, like the Mekong-Salween divide, clothed with luxuriant forest, is covered with thorny scrub below, coniferous forest above, in which the larch, absent from the Mekong-Salween divide, is predominant at high altitudes. Beyond this range again, in the Yangtze valley, also arid, the flora is typically Chinese, probably without a single Burmese species.

We have then established these facts, namely, that the monsoon carries as far east as the Salween valley,[1] of which the flora (and it may be remarked the fauna also) is closely related to that of the Burmese hinterland; and secondly, that the Chinese flora is found as far west as the Yangtze valley and Mekong-Yangtze divide, so that the two meet hereabouts, but are sharply divided by the Mekong valley and Mekong-Salween divide.

Now, it being granted that the Himalayan and Chinese floras are closely related, we can only suppose either that they have been or are at present in close touch with one another, or that both are derived from a common source.

Owing to the east-and-west trend of the main Asiatic axes of uplift, it is difficult to imagine any common source of supply which is not at one or other end of the axis, thus causing the flora to flow from east to west or *vice versa*, and pass successively from one region to another. The only alternative is to suppose one of the parallel northern ranges, the flora of which was driven southwards by the advance of the ice, as the common source; in this way only could the Himalayas and Western China have been peopled simultaneously instead of successively from a single source. This theory assumes that the Himalayas, the north-and-south-trending ranges already referred to, and the tangled mountains of Western China must once have had practically the

[1] *I.e.* south of latitude 28°. North of this point local conditions make the valley extremely arid. The transition is abrupt and startling.

same flora, and consequently that any differences between them must have arisen since. The differences, however, are marked and will have to be accounted for somehow, so that we are no nearer a solution of the other problems, and the theory will not account for certain peculiarities in the distribution of the genus *Primula*.

If then we reject the theory of a simultaneous origin for these two floras, we must assume that they have mingled, or successively originated from a common source: and having satisfied ourselves that, under present conditions, the Himalayan and Chinese floras are separated by impassable barriers, viz. the north-and-south-trending ranges with deep arid valleys in between—it being a well-established fact that similarity of flora and fauna indicates not only land connection, but in the case of plants the absence of any great physical barrier such as a desert or high mountain chain—we are justified in assuming the previous existence of a continuous range stretching from the north-west frontier to well within China. This hypothetical range, the real previous existence of which I shall endeavour to prove, will in this paper be referred to as the Sino-Himalayan range, while the flora of the Himalayas and of Western China will be referred to collectively as the Sino-Himalayan flora. It will be necessary to inquire in the first instance how this range came to be so completely severed by the north-and-south-trending ranges already described.

Retreat of the Ice: Climatic Changes.

Leaving out of account the question as to how mountain ranges are formed in the first instance, we shall see presently reason to believe that these north-and-south-trending ranges were thrust up subsequent to the uplift of the Sino-Himalayan range, interrupting its continuity; and an examination of the floras of these parallel ranges will give a clue to their mode of formation as an irruption area severing the direct continuity of the Sino-Himalayan range.

Comparing the floras of the Mekong-Salween and Mekong-Yangtze divides, though separated only by the deep and narrow Mekong valley, we find striking differences, not so much in the floras themselves—though that too, especially

in the forest belt, is very considerable—but in the plant formations, showing clearly enough the effects of climate, especially rainfall. But the Mekong-Salween divide, being on the edge of the monsoon area, its flora might be supposed to have originated in the west, while the flora of the Mekong-Yangtze divide might be supposed to have originated in China, thus accounting for any differences observed. I will only remark here that the most typical plants of the monsoon jungles, west of the 'Nmai-hka (or eastern branch of the Irrawaddy), *e.g. Pandanus*, rattans and other palms, tree ferns, many species of *Ficus*, climbing ferns (*Lygodium*), etc., are entirely absent from the Mekong-Salween divide, and will prove in the sequel that this range and the Mekong-Yangtze divide, whatever their differences now, must once have had the same flora; further, that the Mekong-Salween divide has still—but may not long retain—the same flora as the Salween-Irrawaddy divide. The obvious inference is that these three parallel ranges were peopled from a common source, and that a change of climate, amounting to a pushing back or limiting of the south-west monsoon, has been, and probably still is, taking place in this area.

During two seasons spent at Atuntsu I have climbed a good deal on the Mekong-Yangtze divide between latitudes 27° and 30°, crossing the range by six passes in all, and one result has been to establish the fact that the glaciers there have retreated some distance and are still retreating. This is proved by (i) an examination of existing glaciers on the range, now little more than shrivelled ice-caps moulded like myxomycetes to the rocks over which they flow, and thrusting out blunt icy pseudopodia as it were into the valley: their bottle snouts and distant terminal moraines, the material of which is already almost wholly rearranged by flowing water, complete the picture of exhaustion; (ii) an examination of other parts of the range, where the deeply eroded U-shaped main valley into which open numerous hanging valleys, the rock basins, mostly occupied by lakes, but sometimes silted up, *roches moutonnées*, occasional moraines, and peculiar cirques at the valley heads, prove that glaciers were once present. In the absence of two familiar indications of past glacial action, namely, striae and perched or erratic blocks, I pictured as well as I could

the appearance of these valleys under ice, and with the vision fresh in my mind, journeyed across to the Mekong-Salween divide in order to examine more closely the largest of its glaciers (flowing to the Mekong) which are so well seen from the former range. These glaciers, it may be remarked, are extremely difficult of access, as they flow in narrow sheer-sided gorges and over steep beds which at one point are generally precipitous or nearly so, so that the glacier comes staggering down in a tumult of fantastic pillars. This comparison convinced me that the rarity of lateral moraines and absence of perched blocks followed naturally in the case of these short[1] steep glaciers, enclosed in gorges, and that did these glaciers on the Mekong-Salween divide disappear, neither perched blocks nor lateral moraines would be left to prove their previous existence, nor would easily recognisable terminal moraines be met with. One important result, however, for which I was not prepared, was the discovery that these glaciers too have retreated some distance, and are evidently still retreating, and, as this is an important point, it will be as well to go into it in some detail. Examining the foot of the largest glacier—the only part of it accessible to any but a party of expert climbers—I found it to terminate in several tongues, sloping gradually to the stream-bed. Down in the valley below were gravel terraces cut out by the stream, and looking upstream, the left bank (facing south) was seen to be a line of sheer cliffs which soon reached a height of several hundred feet; hanging valleys opened into the main valley on either side, all the streams from the northern ridge cascading on to the glacier. From a little above the glacier foot, and extending for half a mile beyond it down the valley, was a high and steep bank of earth almost bare of plants for half its height, but covered at the summit with forest; this was in fact a very perfect lateral moraine, in which I found scratched stones. Further, the moraine showed indications of a step structure, suggesting periodic fluctuations in the retreat of the ice. The lowest part was quite bare, then appeared a few small plants struggling to establish themselves, while above the highest step (marked A in the

[1] The longest glacier was not more than five miles in length, probably less.

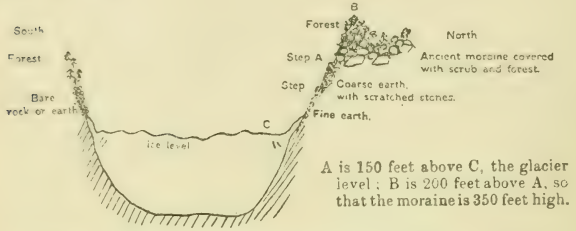
sketch) the moraine was clothed with scrub and forest growing amongst boulders, the material increasing in size from below upwards. Across the valley on the side facing north, the ice lay flat against the sloping valley side a little above the general glacier level, and above that again came a smooth bank of bare rock and gravel, with no plants, evidently left uncovered by the sinking glacier. Fir forests extend right down to the upper limit of this bare bank.

The last half-mile of the glacier surface was fairly smooth and not much crevassed, such crevasses as there were being mostly longitudinal or radial; but looking up the gorge I perceived that the ice stood well away from the cliffs on the north (south-facing) side, so that any material falling from above was, like the streams, instantly engulfed, leaving no trace of a lateral moraine. The Tibetans told me that forty or fifty years ago the ice extended further down the valley, and indeed the boulder-gravel banks and a certain planed appearance of the rocks suggested that it had once nearly reached the Mekong, a distance of little over two miles from the present snout. Finally, at the point where the ice came pouring over the precipice in a fantastic procession of séracs, I found just below the narrow cliff path which winds up the ice of the spur high above the glacier, the well-preserved remains of yet another lateral moraine at least 200 feet above the ice and stranded in a bay of the cliffs.

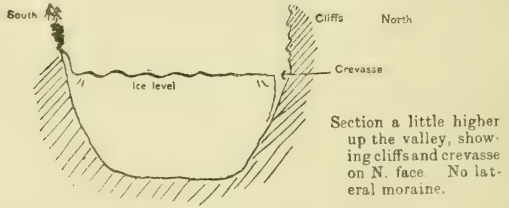
Now is this retreat of the ice apparent or real?—has the glacier merely carved out this gorge sinking lower and lower, and stranding these moraines as it did so, like certain deceptive "raised" beaches, or has the ice actually decreased in volume owing to diminished snowfall? Bearing in mind that we have established the actual retreat of the ice on the Mekong-Yangtze divide, there is good *a priori* evidence for its retreat in this case also. But we have definite proof of its actual retreat in the extension of a lateral moraine not only for three hundred feet *above* the glacier (see sketch), but also for half a mile *beyond* the present glacier foot. As to how these extraordinary gorges were produced in the first instance, whether eroded by water or ice, is not material, though I confess it is a pretty problem to which I can at present give no answer. The

fact that every valley is broken by a precipice seems to suggest faulting at some period, but there is much in the sculpturing of the region that I do not understand.

I found further evidence of the retreat of the ice on the Mekong-Salween divide. At Doker-la, for example, a pass immediately to the south of the snowy range known as Ka´-gur-pw (an elevated part of the divide), the smoothed U-shaped granite valley is broken near its head by a sheer



Section from N. to S. across the glacier near its snout (diagrammatic).



precipice exactly like that over which the bergs fall in the case just cited, and beyond this is the remnant of a glacier. The shape of the valley, its sheer planed walls on which certain marks like deep grooves are cut, the flat meadows filled with sand (evidently once rock basins), and some enormous boulders which may have been transported, are clear indications of a previous extension of the ice at Doker-la. Again, further north in a smaller glacier valley of Ka´-gur-pw, I found a small lateral moraine tucked away above the ice level, and covered with shrub growth. It is evident that, where the cliffs are not sheer, small lateral moraines can be formed, and one valley head was almost

filled with a terminal moraine, above which fragments of a glacier still lingered.

Having satisfied ourselves that the ice is actually retreating from the Mekong-Yangtze and Mekong-Salween divides, we must ask another question:—Is this due to an actual diminution of the monsoon rainfall, or simply to a local deflection or cutting off of the rain-bearing winds?

Now the direction of the monsoon, blowing alternately from the S.W. in summer and the N.E. in winter, is primarily dependent on the rotation of the earth; and the actual existence of the monsoon, its intensity, and the amount of moisture it carries, on the main distribution of the ocean and continental land masses;[1] and since it is almost certain that no appreciable change has taken place in any of these factors within times so geologically recent as those during which the events we are recording took place—say, within Tertiary times—it follows that any marked decrease in the monsoon rainfall must be ascribed to local causes, namely, a deflection or cutting off of the rain-bearing winds. It might, of course, be objected that the retreat of the ice was due in the first instance to a general rise of temperature over the whole region, and not to diminished precipitation at all. But the fact that the glaciers on the Mekong-Salween divide have been affected considerably less than those on the Mekong-Yangtze divide while those on the Salween-Irrawaddy divide have probably been still less affected—even if they have retreated at all, which may be doubted—points to another cause. If there has been a general rise of temperature, why should it affect the glaciers on one range more than those on another?

The Remnant Flora.

I have said that the retreat of the glaciers is due to a diminution of rainfall, and thereby tacitly assumed that the monsoon, or something very like it, was once felt further east. In that case the Mekong-Yangtze and Mekong-Salween divides must once have had very similar floras, whereas it has been pointed out already that their

[1] The relative distribution of land and sea along the continental shelf has, of course, changed appreciably within Tertiary times, but not their relative proportions, nor their distribution in bulk.

floras are markedly dissimilar, especially in the forest belt, where rainfall counts for more than at higher altitudes. What evidence is there that these floras ever were similar? Overwhelming evidence, in my opinion.

I have hitherto spoken of the Mekong-Salween divide as if it were a single entity as regards its flora; in future it will be necessary to distinguish between the range south of Ka'-gur-pw—the elevated snowy portion referred to above[1]—and that north of it. North of Ka'-gur-pw the appearance and flora of the range are identical with what we are accustomed to on the Mekong-Yangtze divide, proving conclusively the common origin of the two floras. This unexpected but welcome discovery, besides setting at rest any lingering doubts on the latter point, satisfactorily explains another curious fact. We have seen that the principal formation on the Mekong-Salween divide is the temperate rain-forest, which contains some elements at least of the monsoon forests further west, though lacking its most characteristic features, and that this formation is wanting on the Mekong-Yangtze divide, being represented by scrub oak and conifer forest; further that there are on the former range alpine meadows, also represented in the monsoon country to the west, which have no counterpart on the Mekong-Yangtze divide. On exploring the Mekong-Yangtze divide in more detail, however, I came across plants from time to time which seemed to have no business there—plants in specialised situations hidden away in protected gullies, or on an outlier of the divide which captured more than its share of the rainfall. There was, for instance, a plant of *Ribes moupinense*, Franch. I found a single bush of it on a shady mountain slope, outlier of the main divide, and in the same place were several bushes of a species of *Euonymus*, which further research revealed in small numbers in a favoured gulley on the main divide. Both are common in the temperate rain forest on the Mekong-Salween divide. On the outlier above referred to I found *Pinguicula alpina*, Linn., a lucky discovery, though some cliffs on the Mekong-Salween divide were yellow with it;

[1] Ka'-gur-pw is a range of snow peaks, the highest about 19,000 feet, some thirty miles in length from north to south. To the Tibetans this range is sacred.

also a species of *Pyrola*, another lucky find. Less striking examples were *Meconopsis pseudo-integrifolia*, Prain, *Primula pseudo-sikkimensis*, G. Forrest, and one or two others which are found scattered on the Mekong-Yangtze divide in favourable localities, but grow in meadows full on the Mekong-Salween divide associated with plants such as *Fritillaria Souliei*, Franch., *Aconitum Souliei*, Franch., found nowhere on the Mekong-Yangtze divide. These accidentals, as it were, I have called the remnant flora, as it seems plain they are survivals from a moister climate which have struggled on in a few localities after the bulk of them had perished under new conditions. What these new conditions were I have already indicated—a gradual desiccation owing to the apparent retreat of the monsoon westwards—and both lines of argument (namely, the graduated diminution of precipitation, as indicated by the progressive retreat of the glaciers from the Salween-Irrawaddy to the Mekong-Yangtze divide, and the remnant flora of the last-named divide) point to the same cause. We can only suppose therefore that rain screens have been interposed one after the other between the monsoon in the south-west and the dry regions[1] east of the Mekong-Yangtze divide—in other words, that these parallel north-and-south-trending ranges have been successively pushed up from the west; that the rise of the Mekong-Salween divide curtailed the rainfall, and hence impoverished the flora, of the Mekong-Yangtze divide, just as the rise of the Salween-Irrawaddy divide is gradually cutting off the rainfall of the Mekong-Salween divide. Each range acts as a rain screen to the next range east of it. Also it is evident that north of Ka'-gur-pw the Mekong-Salween divide has suffered from lack of rain for exactly the same reason as has the Mekong-Yangtze divide further south, namely, the continued interpolation and elevation of rain screens to the west. It is much less difficult to establish the fact of identity between the floras of the Mekong-Salween and Salween-Irrawaddy divides than between the Mekong-Salween and Mekong-Yangtze divides. As already pointed out, desiccation has not proceeded so far in the former case—the Mekong-

[1] Baber, Johnstone, Wilson, and others have drawn attention to the previous extension of the Szechwan glaciers.

Salween glaciers have not retreated far, and the floras are practically the same to this day. At Hpimaw on the Salween-Irrawaddy divide (latitude 26°) not only was the general facies of the alpine flora the same as that met with at Doker-la (Mekong-Salween divide, latitude 28°), but many of the species were identical: *e.g. Polygonum kermesinum*, Ward mss., *Rhododendron* sp. with "black" (port-wine) flowers; *Orchis Chusua*, Don. var.; *Androsace geraniifolia*, Watt; besides species of *Primula* (§ *Omphalogramma*, § *Bella*), *Thalictrum*, *Cremanthodium*, *Mecomopsis*, *Saxifraga*. Thus it would seem certain (i) that these three parallel ranges once had the same flora which, derived from a single source, travelled down the ranges from the north and west (whither all three ranges turn later) and became differentiated at a later date owing partly to (ii) the westward retreat of the monsoon which was cut off from the east by the gradual elevation of the western ranges, and interpolation of more and more mountains, (iii) that in this way two climates, a monsoon climate west of the Salween and a warm temperate climate east of the Yangtze, became sharply defined and separated from each other.

Dispersal of Seeds.

Except under accidental circumstances, the several valleys separating the parallel ranges constitute physical barriers to the spread of plants east or west from one range to another, for the Salween valley north of the Ka'-gur-pw uplift and the Mekong valley throughout its length are extremely arid, and the further one traces them towards their respective sources the more arid do they become. However, we have just seen that beyond Ka'-gur-pw the flora on the Mekong-Salween and Mekong-Yangtze divides is identical, both in the forest and alpine belts, so that we cannot doubt the common source to which both ultimately had access. The only means by which seeds could be transferred directly from one range to another would be (i) wind, and (ii) birds. As regards wind, seeds capable of being carried long distances by wind, *e.g.* those of *Compositae*, *Clematis* etc., might be so transferred from range to range, and there are species of *Clematis* (*e.g. C. montana*, Ham.) and

of *Saussurea* (*e.g. S. obvallata*, Wall.) common to both divides. But seeds only indirectly dispersed by wind (whether they are small and light, like those of most Saxifrages and Gentians, or heavier but shaken out of their capsules by gusts of wind, like those of Meconopsis and Lloydia) could not perform the journey from range to range without first establishing themselves in the valley; and, apart from the question of maintaining their vitality under these conditions, once in the valley they would be beyond control of the dominant wind capable of carrying them right across this area, and under the influence of the strong desiccating up-valley wind. Seeds which are normally dispersed by birds are less common, and in this particular case, it must, I think, be an occurrence so rare as hardly to merit attention. It is true that *Podophyllum Emodi*, Wall., occurs both in the Himalayas and on the Mekong-Yangtze divide, and it may have been transported thither by birds. But the case seems exceptional, for most of the plants with edible fruits in the temperate rain forests of the Mekong-Salween divide, which might be distributed by birds, *e.g.* species of *Pyrus*, *Aristolochia*, *Akebia*, etc., are wanting on the Mekong-Yangtze divide.[1] However, the seeds of the majority of the plants common to two or more of the divides are neither such as are transported by birds, nor such as are directly transported by wind, but only shaken out of their capsules by gusts of wind and spread over a limited area in the immediate vicinity: for example, *Primula bella*, Franch., and *Androsace geraniifolia*, Watt, common to all three divides; *Polygonum kermesinum*, Ward mss., *Rhododendron* sp. aff. *Forrestii*, Balf. f., *Lilium giganteum*, Wall., and others, common to the Mekong-Salween and Salween-Irrawaddy divides; *Meconopsis pseudo-integrifolia*, Prain, *M. speciosa*, Prain, *Primula lichiangensis*, G. Forrest, etc., common to the Mekong-Salween and Mekong-Yangtze divides. Conversely, many plants with seeds whirled freely into the air by wind (*e.g.* many Conifers, species of *Cremanthodium*, *Rhododendron*, etc.) are peculiar to one or other divide. Thus the

[1] It is safe to assert that a plant is common to both divides if one has found it on both. To assert, however, that a plant is confined to one divide is obviously unsafe until one has explored every inch of the others. Such statements must therefore be regarded for the present as only comparatively true.

regular transference of seeds direct from range to range is not in accordance with the main facts of distribution on the ranges: still less will it account for any peculiarities in that distribution—for instance, the remnant flora, the greater specific variety on the Mekong-Yangtze divide, and the occurrence of species peculiar to one range (*e.g. Primula Franchetii*, Pax., *Fritillaria Soulei*, Franch., *Cassiope palpebrata*, W. W. Sm., on the Mekong-Salween divide; *Gentiana sinoornata*, Balf. f., *Saxifraga nigroglandulosa*, Engl. et Irmscher, *Meconopsis integrifolia*, Franch., on the Mekong-Yangtze divide; see footnote, p. 27). Moreover, if wind and birds could be relied on to transport seeds from range to range with some degree of regularity, the floras should be more similar than they actually are, especially in the alpine region, where, as we have seen, the actual climates are not very different. The floras would be adjusted to the circumstances of distribution much more rapidly than either could change owing to changes of climate. But the fact is, even if we assume that a similar flora once clothed all the divides owing to the dispersal of seeds across them, we are still unable to dispense with the theory of successive uplift and formation of rain screens, as this alone would account for the retreat of the ice and the remnant flora. From this we are justified in concluding that the flora has *not* travelled across from range to range, and therefore that it has travelled either down or up the ranges (or both), and hence has been derived from a common source. As it stands, the theory is sufficient to account for all the facts of distribution so far as I know, without dragging in the highly improbable idea that the Mekong valley is not a physical barrier to plant migration. The gradual desiccation of the Mekong-Yangtze divide would bring about changes in the flora, particularly in the forest belt, rain being, as already pointed out, a greater controlling factor in the case of forest than it is with a herbaceous flora, and it accounts readily enough for the remnant flora. It also accounts for a peculiarity alluded to above, namely, the greater specific variety met with amongst many alpine genera on the Mekong-Yangtze divide, *e.g. Meconopsis*, *Gentiana*, *Saxifraga*, *Rhododendron*, *Pedicularis*, etc., a variety greater than anything met with on the Mekong-Salween divide; for as

the glaciers of the former divide retreated, the flora was able to occupy new territory, and, in the inevitable struggle and changed conditions, readapt itself, with the result that new varieties have arisen. But if continuous and free interchange of seeds from range to range took place—and it may be doubted if, under the most favourable conditions, direct communication could be established for wind-borne seeds *except* in the alpine region—there is no reason why these alpines should not now be found on both or all three divides. There is one more significant argument—the alpine and sub-alpine floras of the Mekong-Salween and Salween-Irrawaddy divides are more alike than are the same belts on the Mekong-Salween and Mekong-Yangtze divides, and the same is, I think, true in an even greater degree in the case of the respective forest belts. This follows naturally from the fact that the ice has retreated furthest on the Mekong-Yangtze divide, little or not at all on the Salween-Irrawaddy divide. Such differences as exist between the floras of the Mekong-Salween and Salween-Irrawaddy divides, in the sub-alpine and forest belts, arise from the greater proportion of monsoon species met with on the latter, a subject which will be referred to again. The Mekong valley is as impassable a barrier south of Ka'-gur-pw as it is to the north, but not so the Salween valley which, as already stated, has a more or less monsoon climate south of latitude 28°, so that direct communication between the Salween-Irrawaddy and Salween-Mekong divides is here not improbable. Some of the plants common to the latter divide and to the Burmese hinterland may have crossed directly from one divide to the other; but as it is almost certain that the *alpine* flora common to both divides has travelled down them from the north-west, so is it likely that the southern or monsoon flora, confined chiefly to the forest belt, has travelled up both divides from a common source, and not straight across from the west. The geological history of the western country gives us good grounds for believing *all* the flora common to the Himalayas, the parallel divides, and the monsoon country to have travelled round the perimeter of a circle, and never across it—a matter which will be referred to presently.

Let us now briefly consider the geology of the country,

in order to see if that will furnish a clue as to the building of the parallel divides, and the original connection between the Himalayas and the backbone of China, by which means the similarity in flora must have been brought about. Geology is a subject which permits free speculation, and if in the following notes I have abused the privilege, it is because I have seen but a fraction of the country, and have not gone deeply into the matter. Nevertheless, though it is useless to attempt a detailed description of the region with the scanty knowledge at my disposal, still there are certain prominent and fundamental facts which will go a long way towards telling us what has happened here.

Evidence of Geology.

As far as I have studied the country from the Mali valley in North-West Burma to the Yangtze valley in Yunnan, the mountains all trend from north to south and are separated by deep valleys, which in the north and east are gorges; in the west erosion has been greater than elsewhere, and the mountains are consequently much dissected but often parallel to themselves. There is plenty of evidence to show that volcanic activity has, in the past, played a part in the moulding of the country, though the present manifestations are such as are associated with waning of volcanic forces. Hot springs are abundant throughout the country, and are to be seen issuing from the base of all the parallel ranges; near Tatsienlu in Western Szechwan is a crater lake, and there is another in Upper Burma, while at Tengyueh in Yunnan there is an extinct volcano of very perfect form, with lava beds still intact; a second extinct volcano, Mount Popa, is found in Upper Burma. Earthquake shocks are fairly numerous in Western China, Assam, and Burma, and the whole earthquake area here seems to narrow southwards and eventually to tail off along the volcanic line passing down the Malay Peninsula and through the East Indies. The official annals of Yunnan contain the records of many earthquakes, but the most notable in this region are those of 1850 and 1895 in Western Yunnan, and that of 1897 in Bhotan and Assam.

In the rocks too we find evidence of volcanic activity.

Broadly speaking, this part of Asia is built up chiefly of granite and slate, with some limestone, occasionally crystalline. Slates commonly occur in the river beds, and are generally on edge, but metamorphic rocks are also found at 15,000 or 16,000 feet on some of the divides, and perhaps higher still. Similarly granite is usually found forming the bulk of the ranges (*e.g.* the Salween-Irrawaddy divide, at least in the south, and parts of the Mekong-Salween divide), but it also crops out both in the Yangtze and Mekong valleys. However, the plain of Hkamti in Northern Burma, between the eastern and western branches of the Irrawaddy, and the mountains to the south and west, are composed of sands, gravels, clays, and conglomerates, with leaf beds and shells; near Myitkyina slates and mica-schists appear, the former in the river bed, on edge as usual, the latter with sands and clays, heaved up in north-and-south-trending ridges from 3000 to 5000 feet high. The dip of these rocks is usually south-east, and the schists give evidence of considerable pressure.

It is quite evident that the whole of this tract, at least from the Mali-hka westwards to the Assam Hills, was once a big lake—it is too big for an estuary, the area under water being about a hundred and fifty miles long by forty or fifty broad; and we now see how it is that plants have not migrated due east across the Burmese hinterland from the Assam side, but must have travelled to the north-east, and *then* come down the parallel ranges. At this period the continuity of the Himalayas with the China axis was probably complete, and the parallel ranges probably had no existence, or were only just beginning to appear.

One of the most peculiar features of the country is its apparent westward tilt, as though it was on an inclined plane. Thus it is found that while the general level of the Mali valley is less than a thousand feet above sea-level (the plain of Hkamti is about 1200 feet), the 'Nmai flows at a higher level, the Salween higher again, the Mekong about 1500 feet above the Salween, and the Yangtze about 1000 feet above the Mekong: yet the Yangtze is the biggest river of all, and the Salween a good second, so that the difference of level cannot be set down to erosion, the Mali being the smallest as well as the most sluggish of all.

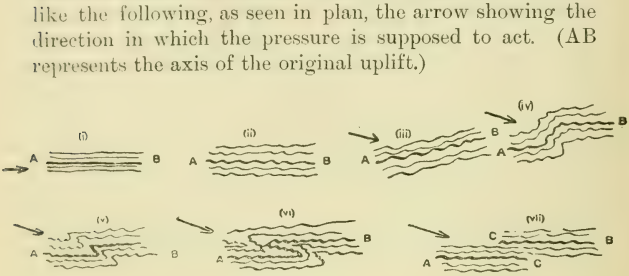
We have already seen good reason to believe that the parallel divides have been gradually pushed up from the west, and if we suppose that the whole area has been bodily pushed up over older rocks, by a movement from the west, we might account for the westward tilt. The highest ranges would thus be found in the east, not only because they would be pushed furthest up the inclined plane, but also because they would have been longest subjected to the pressure. Such a movement might also account for the river gorges, for on cessation of the pressure the weight of the anticlines would tend to drag the mass down the slope again, and the synclines might break. The objection to this is that, if the synclines broke, faulting would almost certainly take place, and probably be conspicuous. I can only say that I have never seen any trace of a fault in any of the river beds, the continuity of the rocks on both sides usually being obvious. On the other hand, some such external force seems to have played a part in the moulding of the country, for the rivers flow quite independently of the strike or dip of the strata, at one point parallel to and a few hundred yards beyond at right angles to the strike, so that apart from such considerations as how much spade-work a river is able to perform under certain conditions, it seems that the valleys have not been simply eroded. Taken in connection with the amount of granite we have seen building up some of the ranges, however, there is another possible explanation of this valley formation. When we consider the pushing up of a tremendous range like the Himalayas, it is evident that a great tension must be set up in the adjacent crust, and lines of weakness would be liable to appear at right angles to the axis of the range, running in this case from north to south. Any subsequent pressure acting from one side—say, from the west—would then be apt to make itself felt particularly along these lines of weakness, and in the case of igneous rocks, with the region in a state of greater or less volcanic activity, it would be along such lines that the originally deep-seated granite would be squeezed out. As it burst through and was further ruckled up by the pressure, the natural result would be for it to throw aside the strata, which would thus come to stand vertically, strik-

ing more or less north and south. (The general direction of strike throughout the region is about N.N.E. to S.S.W.)

The curious fact that the tributary streams of the big rivers often flow parallel to the latter for most of their course, before turning abruptly to enter them, thus subdividing the main ridges, and that this tendency is more marked as one goes westwards towards the supposed source of the pressure, seems to me strong evidence in favour of lines of weakness. Thus the parallel ranges come to be more and more closely packed, though reduced in altitude, as one goes westwards; a fact, however, partly to be attributed to increased erosion. It is germane to the present discussion to draw atttention to the tremendous lateral extent of the Salween-Irrawaddy divide near the sources of the latter river; and as the Tibetans say it takes seven or eight days to cross from river to river, the range is probably double or treble in this region. Five or six parallel ranges separate the 'Nmai-hka from the Mali, and a still greater number the Mali from the Brahmaputra. It is significant that the great mountain ranges of Central and Eastern Asia trend east and west, and that the rivers which break through this gateway to the south begin by flowing eastwards. This is particularly true of the Tsangpo or Brahmaputra, which for hundreds of miles flows due east, and in a lesser degree of the Yangtze and Salween. The Tsangpo cuts its way right across the main axis of the Himalayas, while the other two swing round through the great gap and flow due south, the Salween maintaining this course alongside the smaller Mekong, while the Yangtze presently resumes its journey eastwards. Before doing so, however, it makes a remarkable loop, not like the usual S-bend, but more like the letter N upside down, thus ⅂. Strangely enough, the same whimsical course is followed by three other rivers in this region: the Yalung, a tributary of the Yangtze further east; the Oui-chu', a tributary of the Salween in Eastern Tibet; and the Ngawchang-hka, a tributary of the 'Nmai-hka in the south.

Now imagine an uplift, simple or of fan structure, its long axis trending more or less east and west, subjected to a gradually increasing pressure from one end, the adjacent country having been, as already pointed out, pulled towards

the long axis as the result of uplift, and therefore strained in a direction at right angles to that axis. The uplift might then be to some extent compressed and shortened, and later it might even ruckle slightly; but eventually if the pressure were continued and the mass as a whole did not move, then, unless the direction in which the pressure acted was coincident with the axis of uplift, one of two things must happen: (i) overthrusting of parts of the range, or (ii) bending at right angles to the axis, to be followed by its slewing and eventual shearing. Thus, if the pressure were maintained, we should, in the second case, get structures like the following, as seen in plan, the arrow showing the direction in which the pressure is supposed to act. (AB represents the axis of the original uplift.)



In (vii) shearing has taken place, and the broken ends C C of the axis now overlap. In the last three, the pressure is acting at an angle to the axis.

Imagine these forces (how produced is immaterial, but I have previously suggested a shifting eastwards of the Himalayas to account for the ridging along the border country) at work on a large scale over a wide extent of country, and the pressure to continue after the shearing of the main E.W. uplift (not necessarily a simple syncline) as illustrated. The force is, let it be remembered, acting in a direction more or less at right angles to the lines of weakness already set up by stress in the adjacent crust, owing to that uplift. We should then get, in place of the original lines of weakness, a series of parallel ridges and hollows (anticlines and synclines) running at right angles to the long axis of the original uplift, beginning between their broken ends (C in above diagram), and continuing a longer or shorter distance to north and south, according to circum-

stances. There might at the same time be a slewing round of these secondary ridges while they were being pushed up, or they might from the very first lie rather obliquely to the primary uplift, owing to the pressure acting obliquely as in the diagrams (the Himalayas trend not due east, but about E.S.E.); and they might be pushed up over the broken end of the primary uplift, thus accounting for that apparent westward tilt to which I have drawn attention. Supposing that the irruption area [1] now sagged back, owing to the pressure being released and the dragging weight of the anticlines, the eastern half of the broken uplift might be isolated; while, owing to the oblique direction in which the force is acting (from the W.N.W.), the parallel ridges would lie south rather than north of the gap, and would remain in contact with the western half of the primary

uplift. These changes are illustrated in the following series of diagrams, seen in plan.

In (i) we see the effect of continued pressure in the formation of the ridge CD between the broken ends C C of the main uplift AB (see diagram (vi) previously). In (ii) the number of parallel ridges has been increased to three, and they have been pushed up over the broken ends of the eastern half of the original uplift AB. In (iii) the new ridges have sagged back, remaining in contact with the western half of the uplift, and isolating the eastern half.

Now the result illustrated in (iii) seems to me very much the condition of the country under discussion at the present day, the Himalayas being represented by AC, the parallel divides (in the limited sense, that is, the Salween-Irrawaddy, Mekong-Salween, and Mekong-Yangtze divides) by CD, and the backbone of China, the great divide stretching across the country between the Yangtze and Yellow rivers,

[1] By this term I mean the whole country of parallel ridges from the Brahmaputra in the west to beyond the Yangtze in the east.

by CB. There are, of course, hundreds of complicating and modifying factors of which no notice has been taken, and the tangled nature of the mountain ranges with their endless spurs and dividing valleys has been entirely ignored. Nevertheless, I believe that, underlying all the subsidiary details, this fundamental structure can be traced, and that it is readily recognisable on a good physical map of Asia.

Part of the complicated mountain system in Western China is, of course, easily accounted for by erosion; and the more irregular the distribution of rainfall, the more tangled the system. Other irregularities are caused by rivers cutting their way back and capturing other rivers—thus the Yangtze, cutting its way westwards, appears to have captured its present headwaters after the parallel ridges had begun to be thrown up, and the same might be true of the Mekong and Salween cutting their way back to the north. Again, the peculiar courses of the four rivers already referred to may be due to shearing in two directions at right angles, as described above—for it is certain that there have been two sets of uplift acting at right angles to one another, probably alternating; at present it seems that the movement from the west is going on, so that the parallel divides are increasing in altitude as we go westwards, and the ice retreating from those to the east.

In these rather academic speculations on the geological history of the country, I have tried to account for the fact of the retreating monsoon by the theory of rain screens, and for the formation of the rain screens by supposing a pressure acting from the west to have pushed up these parallel divides, thus breaking the continuity of an original Sino-Himalayan range, postulated to account for the common alpine flora from the Himalayas to Western China, and giving us the present configuration of the region; so far as I can see, there is no way of accounting for the Sino-Himalayan flora, except on the supposition of previous continuity.

We now come to the all-important question, How far does the theory account for the actual distribution of plants throughout the region, their mutual relationships, the great wealth of flora along the Burma-Yunnan frontier,

and the directions in which the plant streams have migrated? I must confess that my botanical and geographical knowledge is far from equal to this task; but, as already stated, some advance in knowledge may be made by working with the weapon at my disposal, and I feel sure that botanists who have gone properly into the subject will be able to furnish evidence sufficient either to supplement or to destroy the ideas here put forward.

The Theory Tested.

The best way to set about the task is to ask what might be expected to result, so far as the distribution of plants is concerned, from the above suppositions, namely: (i) a continuous Sino-Himalayan range stretching eastwards into China; (ii) a subsequent breach formed, and a ruckling in the gap such that the broken halves of the original range are completely severed, while the western half remains more or less in communication with the new parallel ranges at right angles; (iii) immense erosion finally separating the parallel ranges from one another, so that the distribution of species on them is discontinuous. At the same time new rivers are formed and old ones rejuvenated, so that, cutting their way back, they are able to capture rivers belonging to the new system of drainage. A mountain range of not too great altitude is an ideal route for the migration of plants, especially above the tree limit. There is, at least in the earlier days of its uplift, nothing to prevent a plant furnished with the most elementary means of seed-dispersal spreading from end to end, as conditions in the alpine belt at least are likely to be very uniform throughout the length of the range. Consequently, there is not much room for variation in the flora on this account. Even though the rainfall may be considerably greater on one range than on the next, and on one part of a range as compared with another part, the atmosphere is often so full of moisture, even when it is not actually raining, that what with the blankets of cloud hanging over the vegetation and the dew deposited owing to radiation from the bare rock, there is little difference in the alpine flora as the snow-line is approached; melting

ice and snow too supply a good deal of the deficit. We are therefore justified in concluding that if the Himalayas reached out into China, we should find a closely related flora occupying its entire length; the differences might be even less conspicuous than those between the N.W. Himalayan flora and that of Bhotan to-day, as the continuous uplift of that lofty range has brought about changes which in the early days of uplift would not yet have been effected. There is no reason to suppose that any great fluctuating movement of plants backwards and forwards ever takes place; on the contrary, all the north temperate alpine floras at least seem to have invaded their present homes from certain starting-points and then swept forward the length of the range as though impelled from behind, as indeed they often were by the advancing ice cap during the glacial epoch. Thus it appears that a mountain range is not occupied by plants in any haphazard fashion from the surrounding country, but does actually fulfil its apparent function as a transmitter of plants in one direction.

Now the Himalayas trend about W.N.W. to E.S.E., and it is probable that they received their present flora from the N.W. at the time when the northern flora of Europe was being driven southwards by the ice, for the Himalayan flora is essentially European and Mediterranean; and that, owing to the prolongation of the Himalayas eastwards, this flora, once established, would reach China. By the time the vanguard had travelled as far east as it could go, so much time would have elapsed that many changes would have taken place along the length of the range—the disappearance of some species, the domination of others, and so on; in the meantime perhaps uplift has been going on, and the rise of snow-clad portions of the range has cut it up into watertight compartments, so to speak, separated from each other by icy bulkheads between which the floras must henceforth develop independently.

Now suppose the Sino-Himalayan range cut clean across in the manner already described by an uplift at right angles to its axis, as a result of which deep grooves are subsequently trenched between the parallel divides by rivers flowing between. At once the old Sino-Himalayan flora is divided into two camps, an eastern and a western,

between which lies a new line of possible migration southwards. Eventually the new ridges might become severed from *both* ends of the original range; but, to begin with, this is hardly possible, and the irruption area will be in communication with at least one, and possibly with both, ends of the broken range. At the present time there seems to be no connection between the irruption area (*i.e.* the Mekong-Yangtze, Mekong-Salween, and Salween-Irrawaddy divides)and the broken ends of the supposed Sino-Himalayan range (represented by the Himalayas in the west and the Sin-ling and Pe-ling ranges between the Yangtze and Yellow rivers in the east); but quite apart from the acceptance or rejection of the Sino-Himalayan range, it is evident that there was once some sort of connection between the Himalayas and at least the westernmost of the parallel divides. Consider the first ridge thrown up at right angles to the axis of the Sino-Himalayan range; it would maintain connection with the western half of the broken range, if formed in the manner I have indicated, and perhaps with the eastern half also. A second ridge thrust up to the west of the first would have a twofold effect. It would, in the first place, be the natural channel of communication between the Himalayas and the south, thus taking the place of the first range which in time would become isolated, being cut off from *both* ends of the broken range, and in the second place it would alter the climate on the latter, and still more the climate further east. Subsequent ridges pushed up in the west would tend to emphasise these functions, so that the most westernly ranges would gradually become the richest in flora, both on account of being in communication with the source of supply (the irruption area not having been yet dissected by rivers) and owing to more favourable climatic conditions. Thus we see that the flora of the Burma-Yunnan frontier (Mekong-Salween and Salween-Irrawaddy divides) would resemble the Himalayan flora more closely than does the North China flora.[1]

[1] By the North China flora I mean that of the eastern half of the old Sino-Himalayan range, the Sin-ling and Pe-ling ranges between the Yangtze and Yellow rivers. The Himalayan flora is that of the western half.

The following consideration will show that the flora of the eastern range will soon lose many of its Himalayan characteristics. The first hint of an irruption area breaking the continuity of the Sino-Himalayan range and trending from north to south would modify the distribution of climate along that range east of the break, especially as regards the monsoon: it might still receive copious rain, but its seasonable distribution would be different, since the new ranges would to a large extent deflect the south-west winds. The result would be a disturbance of the adjustment reached by the eastern flora, with consequent variation and redistribution till a new adjustment was arrived at, and the point to which I would draw particular attention is that, with the irruption area acting as a channel of communication southwards, two *different* floras will eventually travel down it from the severed ends of the Sino-Himalayan range, and, at least in the early stages, before deep dividing grooves have been cut between the dividing ridges, come into contact. The result would be, not only a new flora, richer than either of its component streams, but a new impetus to variation, partly owing to this mixing of types and partly owing to the greater range of climate encountered during a journey southwards from a continental towards a maritime region—a range still further increased by the retreat of the ice from the easternmost divide, as explained at the beginning of this paper.

Finally, with regard to the parallel ridges themselves, the flora of the most easterly (the Mekong-Yangtze divide[1]) would bear less resemblance to the Himalayan flora than does that of the most westerly (the Salween-Irrawaddy[1] divide), for the reasons stated above: the increased precipitation falling on the western rain screen as a result of the new uplift seems to have given rise to the Irrawaddy, thus draining the lake region and leaving behind the plain of Hkamti.

I have already remarked that the Himalayan flora probably travelled south owing to the fact that the last formed of the parallel ridges was always in more or less

[1] There are numerous north-and-south-trending ranges east of the Yangtze and west of the Irrawaddy, but we are not concerned with these just now.

direct communication with the Himalayas and is probably only separated from it to-day by the Brahmaputra valley. The eastern divides must soon have severed their connection with the western half of the Sino-Himalayan range (though, as we have seen, the floras of the Mekong-Yangtze and Mekong-Salween divides are practically identical in the north) and were probably never in contact with the eastern half; for at their northern extremities all the parallel divides curve round towards the west. Some other cause must therefore be sought to account for the supposed movement of the eastern flora southwards. It seems probable that the real cause in this case was the advance of the ice during the glacial epoch, driving the flora southwards and westwards, by which means not only were the two separated Sino-Himalayan floras brought once more into contact under new conditions, but apparently yet another disturbing element added to further enrich the growing flora of the parallel ridges.

Baber, Johnstone, Wilson, and others have pointed out the widespread glacial phenomena in Western China, and Wilson[1] shows that the Chinese flora, the richest temperate flora in the world, is more closely related to that of the east coast of the United States than to that of the Eurasian Continent. Thus it is evident that in China there has actually been a movement of the flora westwards, and I think it extremely probable that some portion of this extra-continental flora reached the parallel divides, and, mingling with the two halves of the old Sino-Himalayan flora, travelled southwards, giving us the richest alpine and mountain flora within the richest temperate flora in the world, along the Burma-Yunnan frontier. For example, *Juglans* and *Magnolia*, two typical genera of the Eastern United States, are also common on the parallel divides.

Let us now examine a single genus of plants and see how far its distribution is accounted for on our theory —namely, an original Sino-Himalayan range stretching across uninterrupted to China, its continuity subsequently broken by the pushing up of the parallel divides, thus dividing the region into three great plant areas show-

[1] A Naturalist in Western China, by Ernest Wilson (London, Methuen).

ing more or less close relationship: namely, a western, an eastern, and a southern, to be called respectively the Himalayan, the North China, and the Burma-Yunnan floras. For this purpose we will take the genus *Primula*, as Primula-hunting having become a cult, a very large number of species are known and the genus has been the subject of classical work. It is an Eurasian genus, and only one species in either hemisphere extends south of the Equator. *Primula* is divided into a number of sections based chiefly on similarity of habit and foliage, shape and method of dehiscence of the capsule, type of flower, inflorescence, and so on.

Taking Professor Balfour's classification, and looking at the three plant areas we have mapped out as the result of breaking the Sino-Himalayan range, we ought to find, if the genus *Primula* typically represents the case:—

(i) A Himalayan Primula area with endemic species, (ii) a North China Primula area with endemic species, and (iii) a Burma-Yunnan Primula area richer than either of the others in endemic species, but related to both. Area (i) should differ widely from area (ii)—more so than it differs from (iii), the far ends especially being in contrast while the two ends at the break might not differ so widely; but area (iii) should show obvious connecting links with both (i) and (ii), having derived elements from both, especially in the north, in the region of the break, though there is always the possibility of such links being completely wiped out in such a vortex of change, with two or three different floras crowding through this narrow gap.

Now what do we actually find to be the case?

To begin with, Bhotan and Sikkim together form a very rich Primula area—the richest known till the exploration of Yunnan was begun by the French Catholic priests and carried on so successfully by Forrest; the eastern end of the Himalayas may be regarded as area (i), which, as Sir George Watt points out, grows poorer (in Primulas) towards the north-west, while the types attain their fullest development towards the south-east, that is to say, in area (iii). Area (ii) comprises Eastern Szechwan, and extends northwards into Kansu and eastwards through Shensi, where the Sin-ling range is well defined. Its western

boundary is not very distinct, but may perhaps be found somewhere up in the Koko-Nor district. where the Sin-ling range emerges from the tangle of mountains at the northern edge of the Tibetan plateau. It may be considered as extending to the coast (actually the great plains of the Yellow river and the Yangtze intervene), keeping north of the Yangtze, and though not a rich Primula area its flora is in other respects equal to that of any other region of China. The Burma-Yunnan area comprises for our purpose the three great parallel divides between the Eastern Irrawaddy (or 'Nmai-hka) and the Yangtze; but a good deal of country to the east, including a large part of the provinces of Szechwan and Yunnan, must be included in any comprehensive survey of the region. Though the mountains to the west of the 'Nmai-hka belong to the same great system of parallel divides, they, on the other hand, evidently do not belong to this plant area, as I shall endeavour to show later.

In the following table the Primula sections are arranged according to their distribution amongst the three areas named, omitting those from the Tatsienlu area (Western Szechwan), which, as already pointed out, belongs strictly speaking to, or rather is a direct continuation of, the Burma-Yunnan area. Numbers in brackets refer to the number of species in the section. It is almost superfluous to remark that additions and corrections innumerable, some of which may easily be fatal to these arguments, will probably have been made in the classification before this paper is finished —some of my own Primula finds of 1913–1914 are necessarily excluded; but as far as possible I have followed Professor Balfour's classification. For the Chinese Primulas this was comparatively easy, as I have before me Professor Balfour's paper read before the Primula Conference of 1913. Without the knowledge which it contained, and the inspiration it gave, I take this opportunity of saying my paper would never have been written. But for the Indian Primulas it is less easy, as I am not altogether certain of his classification and may have to some extent confused it with the earlier classification of Sir George Watt, to which I must also acknowledge my indebtedness. However, I have done the best I can to be consistent.

North China.	*Burma-Yunnan.*	*Himalaya.*
Obconico-Listeri (1).	Obconico-Listeri (1).	Obconico-Listeri (1).
...	Cortusoides (2).	...
Mollis (2).	Mollis (1).	Mollis (1).
...	Geranioides (2).	Geranioides (2).
Malvacea (1).	Malvacea (4).	...
...	Chartacea (1).	...
...	Davidi (1).	...
...	Sonchifolia (3 ?).	(Allied P. Whitei.)
...	Carolinella (3).	...
Petiolaris (1)	Petiolaris (2).	Petiolaris (13 ?).
...	Malacoides (2).	...
...	Suffruticosa (9).	Suffruticosa (2).
...	Muscarioides (5).	Muscarioides (1).
Soldanelloides (2).	Soldanelloides (3).	Soldanelloides (5).
...	Dryadifolia (2 ?).	...
Candelabra (1)	Candelabra (9).	Candelabra (3).
...	Amethystina (3).	Amethystina (1).
...	Sphaerocephala (2).	Sphaerocephala (6 ?).
Denticulata (1)	Denticulata (3).	Denticulata (1).
...	Glacialis (3).	...
...	Tongolensis (1).	...
...	Sikkimensis (8).	Sikkimensis (3).
Nivalis (1).	Nivalis (6).	Nivalis (3).
...	Omphalogramma (4).	Omphalogramma (1).
...	Bella (1).	Bella (1).
...	Minutissima (1).	Minutissima (4).
...	Yunnanensis (5).	Yunnanensis (4 ?).
Auganthus (1).	...	...
Maximowiczii (2).	...	...
Filchnerae (1).	...	...
Auriculata (4).	...	...
Souliei (2).	...	...
Farinosa (2).	...	Farinosa (7 ?).
Macrocarpa (1).	...	...
Sertulum (2).	..	...
	[Pycnoloba (1 Tatsienlu)].	Verticillata (1).
Totals. § 16, sp. 25.	§ 27, sp. 87.	§ 19, sp. 60.

A study of the above table brings out the following interesting points. In the first place, the irruption area is by far the richest, both in sectional and specific variety. If we extend the area eastwards to Tatsienlu, where the main ranges still trend north and south parallel to our divides, we must increase the number of species to a hundred: but in order to emphasise the points this table brings out, I have confined the Burma-Yunnan area to the divides already described.

In the second place, the Burma-Yunnan area contains elements from both the other areas, no less than seven

sections being represented in all three areas; it is noteworthy that only *one* section (Malvacea) has representatives in the North China and Burma-Yunnan areas, but not in the Himalayas; and only *one* section (Farinosa) has representatives in the North China and Himalayan areas, missing the Burma-Yunnan area. But the section Farinosa is as much American as Himalayan, and may have reached Asia *via* the Aleutian Islands or by whatever route the American flora travelled west—though I think it more likely that both floras were derived from a common source, and radiated from the far north, than that an actual emigration took place.

Thus we see that seven widely distributed sections have representative species in all three areas, while most of the others which occur in the Himalayas spread south into the Burma-Yunnan area, and are represented there by a larger number of species than in the Himalayas.[1] This is the case with six out of eight sections confined to these two regions, but the increase of species is conspicuous in no less than nine sections, including those with forms in North China as well. In two groups confined to the Himalayan and Burma-Yunnan areas (Minutissima and Sphaerocephala) and in one common to all three areas (Soldanelloides) there is a decrease in passing from the Himalayan to the Burma-Yunnan area. Finally, two Himalayan sections (Farinosa and Verticillata) have no representatives in the Burma-Yunnan area. The former is, as already remarked, as much American as Asiatic, and had probably spread over Asia long before the break in the Sino-Himalayan range was formed; there is no *a priori* reason why it should have travelled south with other forms, though it may have done so and since disappeared, or forms of this section may yet come to light in the South. The latter is a N.W. Himalayan type developed in Afghanistan and Abyssinia. These exceptions, if they are exceptions, may all need correction as the exploration of Yunnan and

[1] Sir George Watt, of course, more than hints at the same conclusion when he says: "The forms that spread eastwards from Sikkim to Assam, Burma, and Manipur are seen to belong to an assemblage that attains its greatest development in China, more especially in the mountains of the province of Yunnan" (Observations on Indian Primulas).

the Burma frontier is continued: for while it seems probable that the Himalayas (except perhaps Bhotan) will not yield many new Primulas, there are probably a large number still to be found in the Burma-Yunnan area, the difficulties in the exploration of which can hardly be exaggerated.

The richness of the Burma-Yunnan area is shown as much by the fact that it has nine sections confined to it as by the increase of Himalayan forms there, while the isolation of the North China area is shown by the fact that, in spite of its comparative poverty in Primulas, it also has seven sections confined to it, several of which are unique in the genus. This is an argument in favour of the belief that the North China area has not been recently in communication with the Burma-Yunnan area, or at least not as recently as has the Himalayan area, which it seems possible to me may still be in some sort of communication with it.

A consideration of these facts seems to show then that, so far as the broad distribution of the genus is concerned, they fit in with the theory of a Sino-Himalayan range which has been breached, the eastern end being isolated and the western end remaining more or less in communication with the south, at least till a much later date, *via* a series of curved ranges, wherein, partly owing to its sources of supply and partly owing to physical conditions, changes of climate, soil, and so on, a new and richer Primula area has come into existence, still further augmented by the influx of eastern forms driven backwards and southwards by the ice. Mr. Farrer says that crosses between Primulas occur most frequently, if not exclusively, between extreme species of the same section—in other words, between species of different subsections within the limits of a single section. For example, in the section Candelabra, which forms two colour-groups, we might expect one of the yellow group to cross with one of the purple group, but not a purple with a purple or a yellow with a yellow.

Now at a time when the flora of the earth was more uniform than it is at present—say, in early Tertiary times—the flora of such a continuous range as the Sino-Himalayan would show no very great variation, and Primula itself

might show variation only to the extent of subsectional value, and that only towards the extreme ends of the range. Consequently with the coming of the break, and the subsequent driving in towards the common centre of the eastern and western floras, by the means indicated, these varieties might be brought together at the break, and, travelling southwards in company, give rise to a host of new forms.

It need scarcely be said, however, that if the Sino-Himalayan range theory is to account for the broad distribution of the Primulas in this part of Asia, it must also to a large extent account for (i) any peculiarities of distribution in the genus, both in Asia and elsewhere, since these three areas now constitute the great Primula area of the world, accounting for about 80 per cent. of known Primulas; (ii) for the distribution of other alpines in this region; and (iii) for the distribution of plants in the valleys as well as on the ridges, and for the limits of meeting floras, *e.g.*, the Chinese and monsoon (Indo-Malayan).

To take first the detailed distribution of one or two sections which call for remark. The range of § Candelabra is as follows. Two yellow-flowered species occur in the Himalayas, and the section then expands as usual along the Burma-Yunnan area, where we find three yellow-flowered species (a fourth is known from Tatsienlu) and a new colour group (purple) with five species; the group extends westwards into Burma, where *P. helodoxa*, Balf. f., and *P. Beesiana*, G. Forrest, are found, and southwards into Java, where a single yellow-flowered species is found. Now going east across the irruption area we find one purple-flowered species in Eastern Szechwan—but this may belong to the Burma-Yunnan area—and two purple-flowered species from the Far East, one Japanese and one Formosan. Here it appears that the purple-flowered species of the east and the yellow-flowered species of the west have met in the irruption area and travelled south in company, giving a fresh impetus to development in the section.

It may be pointed out here that nearly all the Burmese Primulas known are really Yunnan Primulas. I myself found more than a dozen species on the western slopes

of the Salween divide in 1914, and these include *P. oboanica*, Hance, *P. Bessiana*, G. Forrest, *P. bidentata*, Balf. f., *P. latiloba*, Franch. (I believe), *P. sonchifolia*, Franch., and perhaps two more of the § Sonchifolia, one of § Omphalogramma, and at least three new species not yet assigned to their proper sections, besides others. Yet I believe very few Primulas (*e.g.*, *P. Listeri*, King) have been found in Western Burma, though the mountains on the Burma-Assam frontier are quite high enough for them: while I venture to prophesy that, high as are the ranges which separate the 'Nmai-hka from the Mali-hka, very few Primulas will be found there when those unknown mountains, so well seen from Laza, come to be explored. For the same reasons, stated below, I believe that few Primulas will be found on the high mountains which, curving round from Assam north-eastwards, form the northern boundary of Burma, as far as the point where the 'Nmai-hka cuts through. West of the 'Nmai-hka the flora is entirely Indo-Malayan and monsoon. Screw-pines, rattans and other palms, tree ferns, and a great variety of *Ficus* trees, epiphytic orchids, climbing Aroids, etc., grow there in profusion. Crossing the divide (8000 feet) between the 'Nmai-hka and the Mali-hka in latitude 27°, not only did I see no sign of any Primulas on any of these parallel ranges, but no sign of anything other than endless monsoon-forest; yet many species of Primula grow below 8000 feet, amongst an assemblage of alpines or subalpines, under very similar conditions of climate, in the Hpimaw Hills.

P. Forbesii, Franch., is recorded from the Shan States, Burma, but Professor Balfour remarks that he doubts the identification. There would, however, be nothing remarkable in its appearance on the eastern frontier, as regards distribution; but when Mr. W. G. Craib remarks[1] of *P. oboanica*, Hance, recently said to have been found in Upper Burma (probably the same plant that I came across), "This is the first record of its occurrence in India," he must be interpreted as referring to a corner of Further India. For the purposes of distribution, Burma east of the 'Nmai-hka is part of the Yunnan area, while the Assam-Burma frontier is linked up with the Himalayas.

[1] Journ. Roy. Hort. Soc., xxxix (1913), p. 186.

I have already referred to the expansion of the Himalayan Primulas as the Burma-Yunnan area is reached; in no sections is this more prominent than in sections Suffruticosa, Muscarioides, Sikkimensis, and Omphalogramma, none of which have representatives in the North China area; but it is equally conspicuous in the sections Candelabra and Nivalis, each of which has a single representative in North China. The two last named are widely distributed—the Nivalis section is universal through *P. nivalis*, Pallas, itself; however, the first four named seem to have originated in the Himalayas and thriven in the Yunnan area; at least they are found nowhere else. One section, Auriculata, confined to North China so far as the three areas under discussion are concerned, is well represented outside China, and suggests in its distribution that the North China area may have been peopled from North Central Asia as well as from the Himalayas, driven thither southwards by the ice. But § Auriculata is nearly related to § Farinosa, a typical American section with representatives also in Japan, so that we have here in these two sections evidence for that westward movement of the flora from America, *via* Japan, already referred to; or possibly Auriculata came from Europe. Anyone who has followed the argument so far will now see why it is that the Himalayan flora is richly represented in Yunnan, but poorly in Western Burma and North China. As Sir George Watt remarks, the forms abundant in Sikkim and Bhotan attain their greatest development in Yunnan; but evidently *not* across Assam and Burma from the west, as might seem the most natural route considering the trend of the Himalayas, a prolongation of which in the same direction would cross the richest Primula area in Yunnan. On the contrary, the alpine flora of N.E. Burma which penetrates southwards to within a degree or two of the Tropics has travelled right round in a vast semicircle from the east end of the Himalayas *via* the mountains north of the Irrawaddy sources, and may possibly still be in communication with the supply. I think there can be no doubt on this point from what I have said on the flora of the parallel divides, evidently derived from a common source, and from the fact that near Hpimaw (lat. 26° N.E. frontier), on the

Salween-Irrawaddy divide, as previously stated, I found not only Primulas but Rhododendrons, species of *Polygonum*, *Orchis*, *Thalictrum*, *Androsace*, and other plants, identical with those found at Doker-la on the Mekong-Salween divide, latitude 28°, besides *Meconopsis*, *Saxifraga*, *Pedicularis*, *Cremanthodium*, *Allium*, and other typical genera of plants.

On this view, such Primulas and alpines as have already been found on the Assam-Burma frontier, and such as may yet be found on the mountains of Far Northern Burma—and I think that the Primulas, at least, west of the 'Nmai will not be numerous—are mere outliers, stranded and isolated, having no connection with the source of supply and failing to find their feet under conditions of climate which are not typically alpine, using that term in a restricted sense. In the same way, the comparative poverty of the eastern end of the original Sino-Himalayan range may be ascribed to the fact that, in spite of the two floras which have swept across it, one from the west and one from the east, it is nevertheless a blind alley, isolated from the present main line of migration of the Primulas. Personally I have never seen a finer alpine hunting-ground than the limestone mountains of Kansu and Shensi, on the great backbone of China; unfortunately I climbed there in the depth of winter when everything was under many feet of snow. However, it does not seem to be rich in Primulas, and the flora is more Chinese than Himalayan, and has probably derived much of its flora from America, which is poor in Primulas. The fact that the great plain of Northern Burma must have been a big lake previous to any great ridging of the Burma-Yunnan frontier took place (for the lake bottom itself is now included in the system of parallel ranges), and therefore previous to the breaching of the Sino-Himalayan range, is sufficient proof that there could have been no communication directly across the Burmese hinterland south of the Irrawaddy headwaters.

But if these arguments hold good, and if there is to this day some line of communication between the Himalayas and the westernmost of the parallel divides (*i.e.* the Salween-Irrawaddy divide) which has not been completely severed, as the divides seem to have been from each other, there must be some remnants of this range, which is nothing less

than a remnant of the old Sino-Himalayan range between the Himalayas and Kansu, especially as the Salween flows eastwards to begin with, parallel to the Brahmaputra or Tsangpo. Undoubtedly such a communication range does exist. It has recently been shown that the Brahmaputra cuts across the main axis of the Himalayas, and a tremendous peak in the N.E. corner of Assam has been identified as situated on the axis. This is what I should have expected, and I will go further and say that there exists a great range of mountains to the south of the Salween sources, reaching from near the Brahmaputra (which has cut across it) on the west, to the sources of the Irrawaddy (Taron) on the east, where it joins on to, or rather becomes, the Irrawaddy-Salween divide, and that that range, the real Sino-Himalayan range, the westernmost peak of which is the snowy giant referred to above, is the home of the Primula and the Meconopsis, the link between the Himalayas and Yunnan.

North of this range the Salween sources themselves probably rise in very dry country, but the southern slopes at least of the range will receive a copious rainfall, not inferior to that of the Salween-Irrawaddy divide itself, and should have an ideal climate for the development of a rich alpine flora.

It may be remarked here that the high peak east of the Brahmaputra on the main axis of the Himalayas is well north of the general trend of that range from W.N.W. to E.S.E.: reference to fig. (vii) on p. 34, and to fig. (iii) on p. 35 suggests the reason for this, and is evidence in favour of that theory.

Finally, we have to consider the valley floras, and the meeting of monsoon (Indo-Malayan) and Chinese floras on that vast meeting-ground, as I have attempted to delineate it, the Burma-Yunnan frontier.

I have already mentioned that the Mekong-Salween divide must be considered in two parts, separated by the snow massif of Ka'-gur-pw. North of that uplift the flora of the divide is similar to that of the Mekong-Yangtze divide to the east; south of it, to the flora of the Salween-Irrawaddy divide to the west. The inference, therefore, is that the divide has been peopled partly from the north and partly from the south (*i.e.* the Indo-Malayan region), though

the similarity of the Mekong-Salween and Salween-Irrawaddy floras also extends to the alpine flora, of course derived from the north. In the valleys we find the same thing. As far north as latitude 28°, where these rivers, breaking through from Tibet, flow in narrow arid trenches, cut off from the rain-bearing winds by the western ranges, and still further desiccated by the indraught of hot air rushing through them, we find at least indications of an Indo-Malayan flora which has spread up from the south. In the Salween valley this is obvious enough, as there are palms, giant bamboos, *Asplenium Nidus*, Linn., and other ferns, Aroids, orchids, and other typical Burmese (monsoon) plants; in the case of the narrow Mekong valley, however, it is only in the shaded gullies that these monsoon plants have a chance of establishing themselves, and there we find *Musa*, *Asclepiadaceae*, ferns, *Citrus*, and other Burmese plants. The flora of the Yangtze valley is much more Chinese. Before the parallel divides had reached any great height, or before the Sino-Himalayan range had been breached, when the Burmese hinterland was a big lake, and the monsoon extended eastwards along the southern slope of the Sino-Himalayan range, all this country would be covered with monsoon forest, and what now remains is evidently the remnant after the advance of the Himalayan and Chinese floras consequent on the rise of the mountains and cutting off of the monsoon rainfall.

Summary.

I have shown that the distribution of floras on the Mekong-Yangtze and Mekong-Salween divides is in accordance with the theory that the parallel divides have been pushed up one by one from the west, the first to appear being the easternmost: also that these two divides and the Salween-Irrawaddy divide derived their floras from a common source which was probably in the west, as shown by the number of Himalayan Primula sections found on them. It could not, however, be overlooked that the similarity of flora extended well into China, and for this reason I suggested an old Sino-Himalayan range of which two broken portions now remain, separated by a great gap; also that the advance of the ice in Western China had driven

the western, with perhaps some admixture of North American, forms westwards towards this gap, through which it had flowed southwards in company with the Himalayan flora; and to this mingling of the floras, together with a good climate, warmth, and rainfall, I chiefly ascribe the great wealth of flora along the Burma-Yunnan frontier and the rejuvenescence of Primula life there. There is every reason to believe that the line of Primula migration was not across Burma to Yunnan, but across S.E. Tibet, and it is on this foundation-stone that I have built. Finally, I have suggested that there is a remnant of the Sino-Himalayan range, now severed by erosion from the Himalayas, left in the gap, and that its flora will prove a real link between those of the Himalayas and Western China. This remnant, which it is my greatest ambition to explore, I place to the south of the Salween sources in an unknown part of Tibet.

The foregoing is a rough working hypothesis to account for such facts as have impressed themselves upon me; but it is only with the object of furthering the investigation, in however small a degree, that I have ventured to put such imperfect notes in writing. Certainly the first criticism of every botanist will be something like this: "Yes, but we would like you to cite the distribution of, say, one hundred plants and show how that distribution agrees with the theory"; or perhaps: "Can you cite a reasonable number of Himalayan plants and show that they are found on the parallel divides, and a reasonable number which are found in your North China area, left behind by the ice—for all would not have been driven back by the ice—and a reasonable number of American species also driven on to the parallel divides? For without this last, what proof is there that the eastern flora has ever driven back into the gap, by which means alone could it have travelled southwards? And if the two, eastern and western, floras did not travel southwards in company, does not the whole theory fail?"

These seem obvious criticisms, and I must confess to being unable to cite individual plants which will prove or disprove the theory for the present. But at least I believe the arguments to be not illogical, while they indicate in which direction further research on the problem of the Sino-Himalayan flora is likely to be profitable.

NOTES ON THE FLORA OF THE ORKNEY ISLES.

BY ARTHUR BENNETT, A.L.S.

(Read 9th December 1915.)

Mr. Magnus Spence's Flora Orcadensis has brought together the numerous papers on this interesting group, lying as they do between the Shetlands and the mainland of Scotland. A glance through this Flora suggests the following notes:

The number of species listed for the Orkneys seems to hold a middle place between those for Shetland and Caithness. The Orkneys have about 84 species not found in Shetland, and 27 not found in Caithness; while Shetland has 40, and Caithness 118 not found in Orkney.

Compared by area, Orkney has 510 square miles, Shetland 325, and Caithness 712.

I have appended a star to plants not included in Mr. Spence's list, but there are several species given in the old lists that cannot be accepted unless refound, while others are obvious errors.

Ranunculus bulbosus, Linn. is a rare species in Orkney, but other stations are given by Col. Johnston in the Scottish Annals.

R. arvensis, Linn.—Given for Orkney in Top. Botany, 15 (1883).

A curious absentee is *Trollius europæus*, Linn., which occurs both in Caithness and Shetland.

**Fumaria confusa*, Jord.—Locally frequent in cornfields above the N.W. end of Loch Stennis. Mainland. 16th July 1900. Rev. E. S. Marshall sp. named by Mr. Pugsley.

**F. Bastardi*, Bor.—Mainland. E. S. Marshall, No. 2415. Pugsley, Supp. Journ. Bot., 1913.

**F. capreolata*, Linn., var. *Babingtonii*, Pugsley.—Birsay. Trail. 1888. "Nearer *speciosa* than *pallidiflora*," Pugsley, *l.c.*

F. purpurea, Pugsley.—Cornfields above Loch Stennis, Mainland. E. S. Marshall, 1900.

**F. densiflora*, DC.—Mainland. Trail in Scottish Naturalist, 1889, 112.

Subularia aquatica, Linn., and *Viola canina*, Linn., are

both unrecorded; they occur in Shetland!, Caithness!, and O. Hebrides!.

**Viola derelicta*, Jord.—Orkney, Stromness. Marshall, Suppl. Journ. Bot., 1909, p. 21.

Arenaria trinervia, Linn.—A remarkable absentee.

**Ononis repens*, Linn.—Mainland. Trail, 1888.

Hypericum pulchrum, Linn., var. *decumbens*, Rostrup. —Stromness and Sandwick. E. S. Marshall, 1900.

Lupinus nootkatensis, Donn. — Heath, Feavel, Sandwick, 1883. Trail. "Escaped from a cottage garden more than twenty years ago." Found on "brecks," *i.e.* heath with top spit pared off. H. H. Johnston in Bot. Exch. Club Rep. for 1886, p. 146 (1887).

Trifolium hybridum, Linn.—Sandy island. A Somerville cat., 1898.

T. agrarium, Linn.—Mainland. H. H. Johnston, 1912.

Vicia sepium, Linn., var. *montana*, Koch.—The authority for this is Babington, Man., ed. i, 80, 1843. "*V. angustifolia*, Koch (1840) = *V. montana*, Froelich in litt."

Alchemilla alpina, Linn.—Not found; in Caithness!, O. Hebrides!, and Shetland!.

A. alpestris, Schmidt.—Sandy island. Somerville cat., 1898.

A. pratensis, Schmidt.—Salmon in Journ. Bot., 1914, 289.

**Potentilla procumbens*, Sibth.—Mainland, 1888. Trail!.

**Geum intermedium*, Ehrh.—Gillies herb. Watson, Top. Bot., 1883, 130.

Callitriche polymorpha, Lonnr.—Mr. Spence tells me he is afraid "he made a too hasty decision respecting this."

The record of *Sison Amomum* is a mistake. Col. Johnston writes: "The plant is *Levisticum officinale*, Koch. This may have been introduced by being used in veterinary practice."

Epilobium ligulatum, Baker.—Mainland. Trail!, 1888.

E. hirsutum, Linn.—Mainland. Trail, 1888.

**Hieracium sarcophyllum*, Stenstr., var. *expallidiforme*, Dahlst.—Orkney. Trail in Ann. Scot. Nat. Hist., 1906, 97.

**H. Orarium*, Lindeb.—Orkney. Trail, *l.c.*

**H. anglicum*, Fr., var. *cerinthiforme*, Backh.—Orkney. Trail, *l.c.*

H. strictum, Fr.—Hobbister rocks, Orphir. Syme.

Sedum acre, Linn. — S. Ronaldshay. Sandy island. A. Somerville cat., 1898.

Pimpinella Saxifraga, Linn.—Picaquoy, 1849. R. Heddle herb. t. Johnston. Heathy hillside, 320 ft. alt. Hoy, 1912. H. H. Johnston.

Cirsium arvense, Scop., var. *horridum*, Koch.—Above Free Church Manse at Orphir. Syme in Bot. Exch. Club Rep. 1872–4, 27.

Carduus arvensis, Robs., var. *setosus* = *Cirsium setosum*, M. Bieb. Birsay, Orkney. Trail sp., August 1888.

**Arctium minus*, Bernh.—Sandy island. A. Somerville cat., 1898.

Campanula rotundifolia, Linn.—This is the only county it is not recorded for in the British Isles.

Arctostaphylos alpina, Spreng.—Hoy. Fortescue, Exch. Club Rep. for 1882, 75 (1884).

Pyrola rotundifolia, Linn.—Rousay. Miss G. Gold, 1869. Ann. Scot. Nat. Hist., 1904, 252.

Primula scotica, Hook.—Introduced to N. Ronaldshay by Dr Trail. Fortescue in Scot. Nat., 1881–2, 375.

**Euphrasia latifolia*, Pursh.—Orkney. Marshall, 1901.

**E. nemorosa*, Mart.—Moul Head, Deerness, 1884. W. I. Fortescue sp.

**Rhinanthus rusticulus*, Druce.—South side of Loch Stennis, Mainland. Shoolbred and Williams. Marshall, Journ. Bot., 1903, 295.

Scrophularia nodosa, Linn.—Remote glen in Hoy, June 1914. Col. Johnston in litt.

**Atriplex littoralis*, Linn.—Mainland, Orkney. Trail, 1888!.

**Rumex conspersus*, Hartm. (*R. domesticus* × *obtusifolius*).—Given for Orkney by Syme in Top. Bot., 358.

The Orkney specimens I have seen of *R. obtusifolius*, Linn., fall under *R. Friesii*, Gren. et Godr.

R. pratensis, M. et K.—Swanbister and Gear, Orphir. Syme.

I have seen no Orkney specimen of the Shetland × *R. propinquus*, J. E. Aresch. = *R. domesticus* × *crispus*. It occurs on Fair Isle, between the Orkneys and Shetland. Straker sp.

R. crispus, Linn, var. *granulatus*.—Swanbister, 1873. Syme sp.

**Betula glutinosa*, Fr.—Orkney. Syme in Top. Bot., 372.

**Pinus sylvestris*, Linn.—Orkney in post-glacial deposits. Niven in Rep. Brit. Assoc., 1901, 840.

The record of *Ceratophyllum demersum*, for Loch of Ayre, Kirbister, is an error of Heddle's, his plant being *Utricularia vulgaris*, as shown by the specimen in Col. Johnston's herbarium. *U. vulgaris* was recorded in Top. Bot., ed. i., 1874, 319, by Boswell.

**Potamogeton interruptus*, Kit.—Loch of Stennis, 1888. Trail sp., and E. F. Linton sp.

P. pectinatus, Linn.—Kirbister Loch. Syme sp., 1888.

P. marinus, Linn. = *P. filiformis*, Nolte !.—Loch of Birsay and Burn of Hundland. Syme sp. Swanbister, 1852. E. F. Bennett sp.

P. pusillus, Linn.—Loch of Kirbister, Orphir, 1878. W. I. Fortescue sp.

P. heterophyllus, Schreb.—Loch of Harray, Orkney, 1852. W. I. Fortescue sp. A form of the species closely simulating twenty-one American specimens. Peduncles 6 inches long, upper floating leaves 1 inch × $\frac{3}{8}$ inch.

P. lucens, Linn.—Muckle Water, Rousay, 1890. W. I. Fortescue sp. A large-leaved form simulating *P. longifolius*, Gay, but wanting the strict even-sided leaves of that plant and the dark colour. Leaves up to 10–11 inches by $1\frac{1}{4}$ inches wide, acute-acuminate, with wavy margins. The only specimens I have seen to approach it are from Siberia. Dr. Augustinowicz.

**Zannichellia palustris*, Linn.—Kirbister Loch, 1850. Syme.

Juncus biglumis, Linn, p. 78.—Must be an error; no authority given, and I can find no record.

J. triglumis, Linn.—This appears to be an addition to the Flora. It occurs in Shetland !, but not in the O. Hebrides.

J. compressus, Jacq.—Neill's record of this would have little weight. Syme knew the plant, yet said he had only seen it in Watson's station in Surrey. *J. compressus* is rare in Scotland. Dumfries, Kirkcudbright, Edinburgh, and Dumbarton are the only counties from which I have seen it.

Luzula pilosa, Willd.—"Not reported for many years,"

p. 79. It seems strange that so common a species has been overlooked. Still both in Shetland and Caithness. *L. sylvatica* seems to be the commoner species.

Carex limosa, Linn., p. 84.—Another new record for the Isles in the Flora.

Carex Oederi, var. *oedocarpa*, And.—Marsh near N. Dam, Hoy. 1886. Stony loch shore, Loch of Kirbister, 1913. H. H. Johnston.

**Koeleria cristata*, Linn., sub-sq. *britannica*, Dom.—Orkneys. E. S. Marshall, Ann. Scot. Nat. Hist., 1906, 32.

Festuca bromoides, Linn.—Shell sand and shingle in Bay of Skail. Mainland, 1913. H. H. Johnston.

Lastrea dilatata, Presl., var. *collina*, Moore.—Trail in Ann. Scot. Nat. Hist., 1907, 229.

Equisetum palustre, Linn. var. *nudum*, Newn.—Trail, *l.c.*, 230.

**Isoetes lacustris*, Linn.—Hill lake, Peerie Water, Rousay, 1901. A. Somerville sp. Reported but not accepted by Mr. Spence.

Ophioglossum vulgatum, Linn., var. *ambiguum*, Coss. et Germ.—This was discovered by Mr. W. I. Fortescue, 2nd August 1878, on the west end of the Calf of Flotta. Black Craig, Stromness. Miss P. Deuche in Exch. Club Rep., 1877–8, 20 (1879). Veness, Swanbister. Syme.

**Chara fragilis*, Desv., var. *capillacea*, Coss. et Germ.—Rotten Loch, Brims. Waas, Hoy. Col. Johnston in Trans. Edin. Bot. Soc., xxvi, 226 (1894).

**Chara aspera*, Willd., var. *desmacantha*, H. et J. Groves. —Orkney. Ann. Scot. Nat. Hist., 1907, 230.

C. baltica, Fr.—This was found by Messrs. Marshall and Shoolbred. 13th July 1900; and by Mr. Crawford, 31st August 1900.

At pages 138–9 is a "Note on a New Primula found in Orkney by Mr. M. Spence." by C. E. Moss, D.Sc., F.L.S., F.R.G.S.

Plants grown by Mr. Hunnybun "had capsules 1·5 to 2·0 times as long as the calyx; with narrow, less compact, more spathulate, and more obtuse leaves." Then Dr. Moss finds that Mr. Spence's plant verges towards *P. stricta*, Fries, a Scandinavian species, and *perhaps is actually that species*. There is certainly no climatic reason against

stricta as a Scottish species; but an examination of fifty-two specimens of *scotica*, among them a third from Orkney, from Mr. Spence, and a specimen of the variety itself, hardly sustains the idea of *stricta*.

Twice the length of the calyx is certainly very unusual, but half as long again occurs in many; and *stricta* is a taller, more gracile species, with the leaves "subtus nudiusculis," not "subtus farinosis," as in *scotica*. It seems to be better to adopt Dr. Moss's name of var. *orkniensis* for the plant.

To the bibliography should be added Low's list of Orkney plants in Barry's History:—

1. A second edition in 1808, by Rev. J. Hendrick.
2. Another in 1813, edited by W. E. Leach.
3. Syme in Bot. Soc. Edin. iv, 47–50 (1850).
4. Col. Johnston in Trans. Bot. Soc. Edin., xxvi, 207–226 (1914).

There are still about fifty species reported in various lists, etc., that have not been confirmed, and are probably mostly errors.

Periodicity in Transpiration. By Sophie J. Wilkie, B.Sc. (Two figures.)

(Read 14th October 1915.)

Periodicity in transpiration has been recorded by various research workers, and the evidences up to 1904 have been collected by Burgerstein in his monograph Die Transpiration der Pflanzen (Jena, Verlag von Gustav Fischer, 1904). A daily maximum has been obtained, and was found to occur any time between the hours of 9 a.m. and 3 p.m., varying with the different species of twigs experimented upon.

Unger (Sitzb. d. k. Akad. der Wissensch. Wien, Bd. xliv, 1862, pp. 181–327) was the first to accept this periodicity, but his experiments were not performed under constant conditions.

Sachs (Landw. Vers. Stationem, Bd. i, 1859, p. 203) believed in the rhythm of transpiration on analogy with growth periodicity.

Sorauer (Forsch. a. d. Gebiet der Agrikultur Physik von Wollny, Bd. iii, 1880, p. 351) observed a maximum of transpiration in the late forenoon and early afternoon, and a minimum before sunset.

Baranetzky (Bot. Zeitung, tom. xxx, 1872, p. 65) denies the existence of a periodicity, and is of the opinion that the plants transpire more during the night than in the daytime, mentioning that the loss of water is steady but not periodic.

Eberdt contradicts Baranetzky's views from the results of his own experimental work.

More recent research on periodicity in transpiration has been carried out by C. C. Curtis (Bull. Torrey Club, tom. xxix, 1902, p. 363). Curtis took weighings every hour for a period extending over twelve hours or less, and the temperature and humidity of the laboratory were kept as constant as possible. He obtained a maximal value for transpiration about the middle of the day, and minor fluctuations independent of the light intensity were also recorded. Experiments were performed under normal conditions in constant illumination and in the dark. He found that the curve in the dark sometimes was in keeping with that obtained under constant illumination, but it was more often very erratic. The graphs obtained by Curtis for transpiration resembled Sachs' curve for growth, Vesque's curve of absorption, and Detmer's curve for the periodicity of exudation of fluids from cut stems and fluid tensions. The transpiration graphs obtained by Curtis varied for every plant experimented upon, and for the same plant no two graphs were ever alike.

In order to have more positive proof of the phenomenon of periodicity, it was necessary to procure graphs of at least twenty-four hours' duration, and for this purpose the apparatus already described at the June meeting of the Society, 1915, was used.[1]

The plants experimented upon were

1. *Pinus sylvestris.*
2. *Opuntia occidentalis.*
3. *Lilium rubrum.*

[1] See Trans. Bot. Soc. Edin., xxvi (1915), 432.

In every case records continuing over several days were obtained, and as far as possible they were uninterrupted. The temperature was kept as constant as possible, the variation being from 2° to 4°. The percentage humidity was on an average between 60 and 70.

A. *Normal Conditions of Light and Dark.*

1. *Pinus sylvestris.*

(1) 11th June to 23rd June 1914.

The natural conditions at that time were approximately sixteen hours' light to eight hours' darkness. Transpiration was found to be more active during the light than during the darkness period, the ratio being as 1 : ·32, while the ratio of light to dark is as 1 : ·5

An analysis of the hourly graph shows that at this season there is on an average a maximum of transpiration at 4 o'clock in the afternoon, a minimum at 3 o'clock in the morning.

(2) 25th November to 18th December 1914.

The conditions as regards the illumination of the plant at this time were eight hours' light to sixteen hours' darkness—just the exact reverse of the state of affairs in June. In this case the average mean ratio of transpiration in light to transpiration in the dark is 1 : 2·9, while the ratio of light to dark is as 1 : 2.

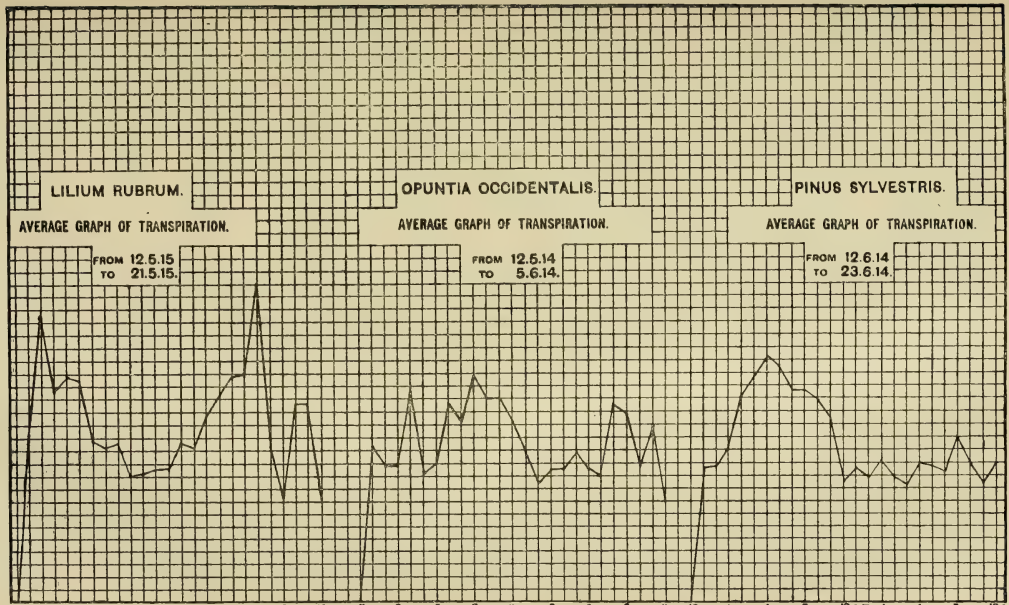
The hourly graphs show as an average a maximum at 4 o'clock in the morning, a minimum at 5 p.m.

(3) 19th January to 19th February 1915.

In this case the ratio of light to dark is for January as 1 : 2, and for February as 1 : 1·4. Here again the figures show transpiration during the period of darkness to be greater than that of light, although the difference is not so marked as in the November-December records; the ratio of transpiration in light to that in dark is as 1 : 1·5.

The maximal value of transpiration at this time as seen from the average graph occurs at 8 o'clock in the morning. The minimal values are very variable, but approximately there is a minimum at 1 p.m.

PINUS SYLVESTRIS.
AVERAGE GRAPH OF TRANSPIRATION.
FROM 12.5.15 TO 21.5.15.
11 a.m. 2 p.m. 6 p.m. 8 p.m. 11 p.m. 2 a.m. 5 a.m. 8 a.m. 11 a.m.
PINUS SYLVESTRIS.
AVERAGE GRAPH OF TRANSPIRATION.
FROM 12.5.15 TO 21.5.15.
11 a.m. 1 p.m. 4 p.m. 7 p.m. 10 p.m. 1 a.m. 4 a.m. 7 a.m. 10 a.m.


LILIUM RUBRUM.
AVERAGE GRAPH OF TRANSPIRATION.
FROM 12.5.15 TO 21.5.15.
OPUNTIA OCCIDENTALIS.
AVERAGE GRAPH OF TRANSPIRATION.
FROM 12.5.14 TO 5.6.14.
PINUS SYLVESTRIS.
AVERAGE GRAPH OF TRANSPIRATION.
FROM 12.6.14 TO 23.6.14.
12 noon. 3 p.m. 6 p.m. 9 p.m. 12 mid. 3 a.m. 6 a.m. 9 a.m. 12 noon. 3 a.m. 6 p.m. 9 p.m. 8 p.m. 11 p.m. 2 a.m. 5 a.m. 8 a.m. 11 a.m. 10 a.m. 1 p.m. 4 p.m. 7 p.m. 10 p.m. 1 a.m. 4 a.m. 7 a.m. 10 a

2. *Opuntia occidentalis.*

12th May to 4th June 1914.

The natural conditions were, at this time, sixteen hours' light to eight hours' darkness. *Opuntia occidentalis* transpires considerably during the darkness period—the ratio of transpiration in light to that in dark being as 1 : ·37, while the ratio of light to dark is as 1 : ·5. The hourly graphs show on an average a maximum of transpiration at 8 p.m., a minimum at 4 p.m., with subminimum at 1 a.m.

3. *Lilium rubrum.*

1st May to 21st May 1915.

The plant at this period would be subjected to sixteen hours' light and eight hours' darkness. The hourly graphs show that the maximal values of transpiration occur at 7 o'clock in the morning and 2 o'clock in the afternoon, the minimal values at 9 p.m. and 9 a.m. The ratio of transpiration in the light to transpiration in the dark is on an average as 1 : ·22.

B. *The Effect of Darkness on Transpiration.*

The types *Pinus sylvestris* and *Lilium rubrum* were experimented upon in the dark room, and in both cases the transpiration was found to be very erratic. In spite of the absence of light, transpiration was very active, and there was evidence of a periodicity, although it was very variable.

Summary.

1. Under normal conditions there is a daily periodicity in transpiration.

2. This periodicity varies in the three types experimented upon.

3. Under all dark conditions transpiration is active but erratic.

I have to thank Mr. R. A. Robertson for his kind assistance in the arranging of these results.

Saxifrages of the Diptera Section, with Description of New Species. By Professor Bayley Balfour, F.R.S.

(Read 7th October 1914.)

The Diptera Saxifrages—we know something of fourteen species—form a compact group marked by peculiar distinctive characters of flower and fruit.

Those of the corolla are the most striking. The petals are unequal. The anterior petal is always the longest and from a shortly clawed base elongates to strap-shaped form and appears like a wing hanging from the front of the flower which is usually placed on the inflorescence with its axis horizontal. This anterior petal is persistent and enlarges during fruiting, becoming at the same time somewhat stiff. One of the antero-lateral petals, that towards the left, is sometimes similarly enlarged, the enlargement being equal in amount, or perhaps more often slightly less. The other petals are also unguiculate but are much smaller, sometimes not a fifth the length of the larger one or ones, and they fall off early. The petals all have a white ground-colour—save in *S. Henryi*, Balf. fil. in which Henry says the flowers are red—and the long petals do not show much blotching; that is reserved for the smaller petals in several species where they are yellow and red-spotted. The flowers in these Saxifrages are then irregular, and it is the presence of these long petals hanging in front of the flower that gave Borkhausen his generic name.

In one species, *S. cuscutaeformis*, Lodd., the petals have been described and indeed figured as having all the elongated form characteristic of one or two petals in other species. In the plants of this species which have flowered at Edinburgh this equality of petals occasionally appears; as a rule the flowers show only slight divergence towards equality.

The large yellow disk is a marked feature in the Section and requires further examination in fresh material of several species. In some—for instance, *S. sarmentosa*, Linn. fil., *S. cuscutaeformis*, Lodd., *S. Veitchiana*, Balf. fil.—the disk

is unilateral, filling the space between the three small petals and the ovary which it embraces. Its median is therefore opposite the gap between the two petals which are or may be enlarged. It increases the irregularity of the flower and is an evident feature, covered as it is by more or less prominent tubercles. In all the other species—so far as I have been able to examine them for the character—the disk is circular and completely encircles the ovary, at the same time showing a smooth surface with at times faint evidence of tuberculation. How far the character of the disk can be used for specific distinction and grouping, investigation will show.

The fruit character of the Diptera Saxifrages is one of much interest to students of adaptations. As the gynaeceum enlarges the pedicel at a point immediately below the torus shows curvature and always in direction towards the posterior side of the flower. The curvature proceeds until the developing fruit becomes inverted with one septal surface closely adpressed to the pedicel. This curvature brings at the same time the large anterior petal, which has been enlarging and stiffening, from its downwardly directed position as a hanging flag in the flower into an erect or nearly erect position on the curved end of the pedicel and above the upward turned base of the fruit. We get then a capsule with mouth directed downwards—the mouth being a transverse slit between the styles, the size of which can be regulated by the degree of drying of the style-bases—surmounted by an erect stiff strap-shaped petal one or more centimeters long. There may be two such petals. The mechanism may be interpreted in terms of seed-distribution, and the suggestion is an obvious one that the petal, exposing a surface to currents of air, is the agent through which vibration is communicated to the stiff thread-like pedicel below, and the seeds protected from wet in an inverted capsule are shaken out easily from the downwardly directed capsule mouth.

The Diptera Saxifrages are all Japanese or Chinese—China claiming nine, and Japan five. One of the Japanese species—*S. sarmentosa*, Linn. fil.—has been sent in dried specimen from China, but it is a doubtful native.

SAXIFRAGES OF THE DIPTERA SECTION.

S. aculeata, Balf. fil. Sp. nov. China.
S. cortusaefolia, Sieb. et Zucc. Fl. Jap. Fam. Nat. in Acad. Muench., iv, 11 (1843), 190 ; Bot. Mag., t. 6680. Japan. Cult. Introd. before 1874, Veitch. Coll. Maries ; or Fortune and Standish.
S. cuscutaeformis, Lodd., Bot. Cab., t. 186. China ? Cult. Introd. before 1815. Loddige.
S. dumetorum, Balf. fil. Sp. nov. China.
S. flabellifolia, Franch. (non R. Brown) in Morot, Journ. Bot., viii (1894), 295. China.
S. Fortunei, Hook. in Bot. Mag., t. 5377. Japan. Cult. Introd. about 1863, Standish. Coll. Fortune.
S. geifolia, Balf. fil. Sp. nov. China.
S. Henryi, Balf. fil. Sp. nov. China.
S. imparilis, Balf. fil. Sp. nov. China.
S. madida (Maxim.), Makino in Tokyo Bot. Mag., vi (1892), 52 ; Yatabe Icon. Fl. Jap., i, 11, pl. vii. Japan. Cult.
S. rufescens, Balf. fil. Sp. nov. China. Cult. Introd. 1908, Bees. Coll. Forrest.
S. sarmentosa, Linn. fil. Suppl. 240 ; Bot. Mag., t. 92. Japan. Cult. Introd. before 1771.
S. sendaica, Maxim., Mél. Biol., viii (1872), 601 ; So Moko Zusetz., viii, t. 16. Japan.
S. Veitchiana, Balf. fil. Sp. nov. China. Cult. Introd. about 1904, Veitch. Coll. Wilson.

Of the fourteen, three of the Chinese (*S. cuscutaeformis*, Lodd., *S. rufescens*, Balf. fil., and *S. Veitchiana*, Balf. fil.), and four of the Japanese (*S. cortusaefolia*, Sieb. et Zucc., *S. Fortunei*, Hook., *S. madida*, Makino, *S. sarmentosa*, Linn. fil.) are in cultivation.

The longest and perhaps the best known species is *S. sarmentosa*, Linn. fil.—the so-called Strawberry Saxifrage, and bearing also several other names: Wandering Jew, Aaron's Beard, Old Man's Beard, Mother of Thousands, Sailor Plant,—familiar to everyone in its white-veined hairy leaves and long runners—the flower with a large yellow one-sided tubercled disk. Cultivated in the East as in the West, it has probably spread from Japan to China where it is found in isolated areas always apparently about large cities. Its variety *tricolor* is a striking well-known greenhouse plant.

S. cuscutaeformis, Lodd., is another plant of cultivation. Its wild habitat is unknown. There is no record of it in the careful account of their Flora by Japanese botanists and it is assumed to be a Chinese plant. It may be regarded as a minute *S. sarmentosa*, Linn. fil., the leaves

very small and not hairy, the flower scapes only a few inches high. The flowers are pure white.

A few years ago Messrs. Veitch sent out under the name of *S. cortusaefolia* one of Wilson's Chinese plants, and a delightful one it is, forming long runners and rapidly making a leaf carpet. It is not *S. cortusaefolia*, Sieb. et Zucc. which is apparently only Japanese. I have named it *S. Veitchiana*. It has orbicular green leaves and small flower panicles and can at once be recognised from *S. cortusaefolia* by its flagella—there are none in *S. cortusaefolia* —and by the unilateral yellow tuberculate disk in the flower —it is circular and smooth in *S. cortusaefolia*. From *S. sarmentosa*, Linn. fil. its bright green leaves, not white-veined, and small inflorescences distinguish it. Occasionally the leaves of the young rooting rosettes on the runners show some white veining.

S. cortusaefolia, Sieb. et Zucc. (*S. japonica* of old gardens) is one of the species which do not form runners. It is widely spread in Japan. Two stories of its introduction are current: one that it came to Britain through Maries, collector for Messrs. Veitch, about the middle of last century; the other that Fortune and Standish introduced it. It was in cultivation before 1874. The stiff fleshy leaves and pure white flowers make it an effective plant, but at Edinburgh not quite satisfactory outside. It is variable. Makino's varietal names *obtusocrenata* and *partita* refer to features of the leaf, and *S. madida*, Makino, is a microform with more delicate leaves more deeply cut.

The palm for beauty belongs to the Japanese *S. Fortunei*, Hook., discovered by Fortune, and known in our gardens for some sixty years. Its fringed rich green leaves, the largest of all in cultivation, with bronzed or bright red underside and petiole, and its large white flowers, make it a welcome plant. Like *S. cortusaefolia*, Sieb. et Zucc. it does not show its best foliage in the open at Edinburgh and its flowers come too late for so succulent a plant in the Edinburgh climate.

S. rufescens, Balf. fil. is the most recent introduction of the group, and is from China. It has come from Bees, Ltd. through their collector G. Forrest. It is a plant of the habit of *S. cortusaefolia*, Sieb. et Zucc., but distinguished

by the densely red-hairy flower-shoots and the petals flushed with red. It is hardy at Edinburgh, and, flowering in July, escapes the mischance to which the late-flowering *S. Fortunei*, Hook. and *S. cortusaefolia*, Sieb. et Zucc. are liable.

Of the other known species not yet introduced there are the Japanese *S. sendaica*, Maxim., an erect grower, with palmatifid cuneate-based leaves and without runners; this character is shared by the Chinese *S. flabellifolia*, Franch. and *S. imparilis*, Balf. fil., both of which resemble *S. cortusaefolia*, Sieb. et Zucc., but differ—the former in its truncate or cuneate leaf-bases, the latter in its truncately topped fruit. *S. geifolia*, Balf. fil. and *S. dumetorum*, Balf. fil. are trailing Chinese species with flagella and leaves the shape of which recalls that of our native *S. Geum*, Linn. The former has copiously branched panicles of small flowers, the latter has inflorescences bearing few branches, and it also has white blotches on the upper leaf surface.

Not one of the unintroduced species noted above gives promise of gardening value, unless perhaps *S. geifolia*, Balf. fil.

It is otherwise with the plant I have named, *S. Henryi*, Balf. fil. This, one of Henry's finds in the neighbourhood of Szemao, is peculiar in the section, having oblique peltate leaves like a begonia, and whilst the upper surface is grey of hue, the under is of a rich purple with darker purple dots all over it. The margins, too, are somewhat prickly. Henry says the flowers are red. For the foliage alone the plant should be worth having—the red flowers add an attraction. Coming from Szemao its hardiness is open to suspicion.

From Szemao comes also another of Henry's finds, *S. aculeata*, Balf. fil., a form evidently nearly allied to *S. Henryi*, Balf. fil. but not showing the brilliant colouring of the leaves, which are here symmetric and develop upon their margins a series of more pronounced prickles. The colour of flowers is not recorded but in the dried plant these have all the features shown by *S. Henryi*, Balf. fil., and may be red as in that species.

That we are to regard as fixed characters the presence or absence of the white veining of the leaf appearing in species of the flagelliferous series is by no means certain.

Thus *S. Veitchiana*, Balf. fil. normally has concolorous leaves, but occasionally young rosettes on the runners show a faint white veining. Again, *S. sarmentosa*, Linn. fil. in certain conditions may have some of its leaves concolorous instead of white-veined; and then there is the var. *tricolor* of *S. sarmentosa*, Linn. fil., with its uncertain blotching. Some experiments begun a few years ago for the purpose of obtaining evidence have been interrupted, but the subject is one deserving investigation. It may show that some of the species are really growth forms of one.

One may group the species in the following key:—

FLAGELLIFEROUS.

Lamina white-veined above. Toral disk unilateral:	
Lamina hairy above	*sarmentosa*
Lamina glabrous above	*cuscutaeformis*
Lamina white-blotched above. Toral disk circular	*dumetorum*
Lamina concolorous above:	
Toral disk unilateral	*Veitchiana*
Toral disk circular	*geifolia*

NON-FLAGELLIFEROUS.

Leaves prickly at margin:	
Leaves peltate	*Henryi*
Leaves not peltate	*aculeata*
Leaves not prickly at margin:	
Leaves palmatifid, lamina cuneate at base	*sendaica*
Leaves reniform orbicular:	
Lamina cuneate or truncate at base	*flabellifolia*
Lamina with basal sinus:	
Lamina bronzed beneath	*Fortunei*
Lamina grey green beneath:	
Flower stems densely red hirsute	*rufescens*
Flower stems more or less pilose:	
Capsule truncate	*imparilis*
Capsule with semi-erect style:	
Leaves thick, fleshy	*cortusaefolia*
Leaves thin, deeply cut	*madida*

I add here technical descriptions of the new species of which I have spoken in the preceding pages, namely:—*Saxifraga aculeata*, Balf. fil., *S. dumetorum*, Balf. fil., *S. geifolia*, Balf. fil., *S. Henryi*, Balf. fil., *S. imparilis*, Balf. fil., *S. rufescens*, Balf. fil., *S. Veitchiana*, Balf. fil.

Saxifraga aculeata, Balf fil.

Planta eflagellifera radicibus fibrosis foliis petiolatis. Folia ad 12 cm. longa; lamina ovata aequilateralis coriacea apice acuta basi cordata sinu clauso, margine cartilaginea

leviter acute dentato-lobata setis aculeatis ciliata, utrinque glauca supra glabra infra maculis rotundis stomatalibus picta: petiolus lamina vix longior setosus basi vaginatus ibique pilis setiformibus rufidulis dense obtectus. Inflorescentia brevis ad 16 cm. alta pauciflora. Caulis et rami (4–5) graciles sparsim rufo-pilosi; bracteae lineares submembranaceae inferiores 2–3 steriles; pedicelli filiformes. Florum forma et color forsan ut in *S. Henryi*, Balf. fil.

Species *S. Henryi*, Balf. fil. verosimilis sed foliis omnibus aequilateralibus non peltatis utrinque concoloribus diversa.

Yunnan:—Mengtz. Cliffs, 5000 ft. Henry. No. 10,316 B.

Saxifraga dumetorum, Balf. fil.

Herba pilosa saepe rufescens flagellifera, flagellis filiformibus plus minusve pubescentibus cataphylla gerentibus. Folia ad 8 cm. longa; lamina cordato-orbicularis vel subreniformis sinu fere clauso ad 2·5 cm. diam. plerumque minor leviter crenato- vel dentato-lobata, lobis verrucula hydathodali marginali instructis, margine ecartilaginea hirsuto-ciliata, utrinque in foliis juvenilibus dense (in adultis sparsim) setoso-pilosa supra viridis albo-maculata subtus areolis stomatalibus rubro-maculata; petiolus laminam longe superans basi vaginatus dense hirsutus. Inflorescentia ad 20 cm. alta; caulis pilis rufis obtectus in triente supremo ramosus, infra cataphylla sterilia tria linearia gerens. Rami pauci breves vix 1 cm. longi 2–3-flori; bracteae breves lineares rufoglandulosae; pedicelli brevissimi. Sepala minuta 2 mm. longa ovato-oblonga glandulosopubescentia trinervia nervis sub apice in hydathodum confluentibus. Petala albida inaequalia, majora ligulata acuta ad 1 cm. longa ad 4 mm. lata penninervia venis adscendentibus, minora plerumque quatuor ad 2·5 mm. longa ovata acuta uninervia. Staminum filamenta subclavata. Ovarium parvum disco circulari etuberculato cinctum.

Ex affinitate *S. Veitchianae*, Balf. fil., foliis maculatis hirsuto-ciliatis, inflorescentia brevissime ramosa notisque aliis distincta.

Hupeh:—Henry. 1885–88. No. 1129. Herb. Edin.

Yunnan:—Pe-long-tsin. Alt. 9600 ft. On rocks under brushwood. Stoloniferous, tumescent, leaves blood red beneath. E. E. Maire. June. No. 11/1914. Herb. Edin.

Saxifraga geifolia, Balf. fil.

Herba ellagellifera radicibus fibrosis et foliis plurimis basalibus petiolatis. Folia ad 10 cm. longa: lamina cordato-orbicularis ad 4 cm. diam. petiolo multo brevior carnosula grosse crenato-lobata lobis crenulatis, margine cartilaginea et hydathodis corneis obscure denticulata hic et illic ciliata, foliorum juvenilium et adultorum pagina inferior plerumque purpurea maculis stomatalibus punctata, superior glabra vel setis paucis conspersa: petiolus ad 8 cm. longus dense hirsutus basi vix vaginatus. Caulis inflorescentiae tenuis pilosus ad 30 cm. altus apicem versus copiose graciliter ramosus, infra bracteis 2–5 sterilibus parvis linearibus praeditus; rami filiformes 3–6-flori pedicellis ultimis 1 cm. longis strictis patentibus glanduloso-puberulis. Sepala oblonga ·75 mm. longa puberula uninervia hydathodo terminali. Petala inaequalia anterius ligulatum 1·5 cm. longum, ·75 mm. latum, acutum uninerve album, caetera quatuor elliptica minutissime ciliata mucronulata 1·5 mm. longa, uninervia basi in unguem attenuata. Staminum filamenta alba anguste clavata, sepalis duplo longiora. Discus luteus parvus circularis ovarium cingens. Carpella ad medium stylorum confluentia; styli albi tenues. Fructus deflexus brunneus stylis divergentibus basi ampliatus supra constrictus poro angusto dehiscens.

Species *S. Veitchianae*, Balf. fil. affinis foliis margine cartilagineis et floris disco etuberculato ovarium circumambiente distincta.

Yunnan:—On ledges of cliffs and humus-covered boulders; on the mountains in the north-east of the Yangtze bend. Lat 27° 45′ N. Plant of 6–12 inches. Flowers white, foliage succulent. G. Forrest. No. 11,438. September 1913.

Saxifraga Henryi, Balf. fil.

Planta radicibus fibrosis foliis petiolatis. Folia ad 20 cm. longa; lamina petiolo brevior peltata inaequilateralis ovata vel ovato-orbicularis carnosa 9–10-lobata margine cartilaginea subdentata aculeato-setosa supra glauca sparsim strigosa subtus purpurea maculis stomatalibus picta; petiolus validus setosus vagina dense ciliata. Inflorescentia ad 40 cm. alta. Caulis pilosus ad medium

nudiflorus cataphylla 3 sterilia gerens, supra multiramosus ramis tenuibus elongatis 3–5-floris bracteis parvis linearibus. Flores rubri (fid. Henry). Sepala 2 mm. longa ovato-lanceolata obtusa puberula trinervia nervis sub apice in hydathodum confluentibus. Petala inaequalia unguiculata, majora 1 vel 2 inaequalia lanceolato-ligulata nervis tribus convergentibus conspicuis pluricostata ad 1·5 cm. longa, minora 4 vel 3 elliptico-oblonga 3 mm. longa acuta uninervia. Staminum filamenta vix clavata petalis brevioribus longiora. Ovarium disco leviter corrugato cinctum; styli longi.

Species ab omnibus Sectionis Dipterae foliis peltatis floribusque rubris distincta.

Yunnan:—Mengtz. South-west mountains. 6000 ft. Flowers red. Henry. No. 9118.

Saxifraga imparilis, Balf. fil.

Herba rhizomate parvo plus minusve pilosa glabrescens. Folia pauca longe petiolata ad 20 cm. longa; lamina cordato-orbicularis vel subreniformis basi aperta ad 8 cm. diam. 7–11-lobata lobis acute dentatis apice verruculosis, margine ciliata, utrinque glabra, vel supra sparsim strigoso-pilosa; petiolus glaber vel pilosus basi vix vaginatus. Inflorescentia ad 40 cm. alta a medio caulis laxe paniculata infra bracteis 1–2 sterilibus nonnunquam fertilibus trifidis et petiolatis suffulta glabra vel leviter pilosa; bracteae supremae lineares; rami 4–7 tenues patentes saepe biramosi 3–7-flori; pedicelli filiformes stricti pilosi. Sepala 1·5 mm. longa oblonga obtusa puberula uninervia. Petala inaequalia, majora 1–2 linearia acuta ad 8 mm. longa uninervia vel obscure trinervia, minora 4–3 ovata lanceolata acuta sepalis duplo longiora uninervia. Staminum filamenta clavata petala superantia. Discus laevis ovarium cingens. Ovarium pulvinatum; styli breves albi erecti. Fructus deflexus apice latior et subtruncatus ore elongato inter stylos horizontaliter patentes dehiscente.

Species *S. cortusaefoliae*, Sieb. et Zucc. persimilis floribus et fructu bene distincta.

Yunnan:—Mi le district. 6000 ft. on rocks. Henry. No. 9917.

Yunnan:—Rocks of Lore-pou. Alt. 9000 ft. Tomentose, flowers white. E. E. Maire. 15/1914. Herb. Edin.

Saxifraga rufescens, Balf. fil.

S. cortusaefolia, Engler et Irmscher in Notes R.B.G. Edin., v (1912), 128.

Rhizoma tuberosum alabastris et vestigiis foliorum obtectum. Folia petiolata ad 20 cm. longa; lamina cordato-orbicularis vel reniformis ad 10 cm. diam. petiolo brevior sinu aperto vel lobis basalibus imbricatis ad tertiam partem 9–11-lobata lobis inciso-dentatis, margine recurva ecartilaginea pilis rufidulis ciliata, utrinque pilosa vel hirsuta supra viridis subtus glauca; petiolus carnosulus validus ruber pilis plus minusve rufis dense hirsutus basi vaginatus. Inflorescentia ad 45 cm. alta; caulis plus minusve ruber et glanduloso-hirsutus infra nudus a medio ramosus; rami rigidi breves plurimi racemose dispositi ex axillis bractearum linearium parvarum horizontaliter patentes ubique dense rufo- et glanduloso-hirsuti 4–6-flori. Florum alabastra rubra. Sepala 1·5 mm. longa ·5 mm. lata oblonga obtusa erubescentia puberula. Petala albida epunctata sed erubescentia, majora linearia vel anguste lanceolata acuta trinervia ad 1 cm. longa 1–1·5 mm. lata, minora oblonga obtusa mucronulata 3 mm. longa 1·5 mm. lata uninervia. Staminum filamenta clavata alba sepala duplo superantia, antheris cinnabarinis. Ovarium globosum disco luteo circulari antice subsulcato cinctum; styli albi breves. Fructus rubescens inter stylos horizontaliter deflexos dehiscens.

Species rhizomate tuberoso et inflorescentia pilis rufis fere nigris glandulosis vestita bene distincta.

Yunnan:—Eastern flank of the Tali range. Lat. 27° 20′ N. Alt. 10,000–11,000 ft. Plant of 6–15 inches. Flowers white, anthers brick red. On moss-covered rocks and banks in shady pine and mixed forests. G. Forrest. No. 2401. June 1906.

Yunnan:—Eastern flank of the Tali range. Lat. 25° 40′ N. Alt. 11,000–12,000 ft. Plant of 9–14 inches. Flowers white, anthers brick red. Moist, shady, and rocky situations in pine and mixed forests. G. Forrest. Nos. 4199, 5059. August 1906.

Yunnan:—Eastern flank of the Lichiang range. Lat. 27° 40′ N. Plant 1–2 ft. Flowers white. Shady situations in and on the margins of mixed and pine forests. G. Forrest. No. 6067. July 1910.

Yunnan:—Eastern flank of the Tali range. Lat. 25° 40′ N. Alt. 10,000–11,000 ft. Plant of 8–16 inches. Flowers creamy white. Shady banks in mixed forests. G. Forrest. No. 6952. 1910.

Yunnan:—Mt. Tahai. Rocks. Alt. 9600 ft. Leaves velvety, ciliate. Flowers white. E. E. Maire.

Saxifraga Veitchiana, Balf. fil.

Flagellifera plus minusve setoso-pilosa. Flagella filiformia cataphyllis instructa rubra sparsin pilosa ramosa. Folia petiolata ad 10 cm. longa; lamina carnosula cordato-rotundata vel reniformis ad 5 cm. diam. petiolo brevior, margine sub-revoluta obsolete late crenulata ciliata, in foliis juvenilibus utrinque setoso-pilosa, in adultis supra viridis glabra infra substrigosa maculis rubris oblongis plurimis stomatalibus punctata; petiolus validus carnosus erubescens setoso-pilosus basi vaginatus. Caulis terminalis erubescens pilosus fere a basi in inflorescentiam pyramidatam paniculatam ad 15 cm. altam ramosus. Bracteae infimae semiamplexicaules vix laminatae, supremae lineares. Rami paniculae 6–8 graciles stricti adscendentes ad 5 cm. longi 3–4-flori; pedicelli filiformes rigidi erecti rubro-glandulosо-pilosi. Sepala ovata obtusa rubro-glandulosa 2 mm. longa trinervia nervis sub apice in hydathodum confluentibus, in anthesi reflexa. Petala unguiculata majora 1 vel 2 anguste lanceolata acuta ad 8 mm. longa 1 mm. lata penninervia albida vel macula basali lutea, minora 4 vel 3 ovata acuta 3 mm. longa 1·5 mm. lata maculis basalibus duabus luteis caeteroquin rubro-maculata penninervia. Staminum filamenta alba anguste clavata petalis minoribus duplo longiora, antheris roseis. Discus unilateralis inter petala minora et ovarium quod aequat tuberculatus aurantiacus. Ovarium pulvinatum; styli albidi a basi divergentes.

Species *S. cortusaefoliae*, Sieb. et Zucc. affinis statura minore, foliis adultis superne glabris non albido-nervosis distincta.

West Hupeh. Wilson. No. 461. June 1900.

The Influence of Different Media on the Histology of Roots.

By Sophie J. Wilkie, B.Sc., Carnegie Scholar, St. Andrews University. (Plate I.)

(Read 14th October 1915.)

The following is a short note on the differences found in the anatomical structure of the roots of *Monstera deliciosa*, Liebm., when grown

(1) In air.
(2) In soil.
(3) In water.
(4) In wet gravel.
(5) In damp soil.

Constantin in a paper published in the Annales des Sciences Naturelles, sér. 7, tome i, 1885, pp. 135 to 178, gives an account of the differences found in the structure of roots when grown in air, soil, and water.

His general conclusions are:—

(1) That aerial roots are characterised by the strong development of the central cylinder and of the vascular and stereom tissues.

(2) That soil roots show a reduction in the amount of pith; sclerenchyma and lignified vessels are of minor importance, and there is a very broad outer cortex.

(3) Water roots are very similar to soil roots, but they differ in respect that they possess large intercellular spaces, and the vascular system is weaker.

In Constantin's opinion the most important point which his research brings to light is that lignin is developed with difficulty in soil and water roots.

Haberlandt (Wollny's Forsch.—Influence of moisture on the development of stereom, 1, pp. v. sqq.) showed that the development of the mechanical tissue is affected by the humidity of the soil. He found that an increase in the water content of the soil had a favourable effect on the development of the mechanical tissue of *Cannabis sativa*, Linn.

The material used for the following work on *Monstera deliciosa* was fixed in corrosive sublimate and after wash-

ing well with water was taken through the graded alcohols to 90 per cent. alcohol. Sectioning was done by hand, and before proceeding to stain the sections were placed in iodine for a few minutes in order to get rid of any mercuric chloride. The stains used were iodine green and picric fuchsine, or Bismarck brown and Ehrlich's acid hæmatoxylin.

The points which were studied in connection with this piece of research were the absorptive areas and the mechanical and fundamental tissues; the material did not permit of a comparison of the vascular systems.

Structure of the Adult Aerial Root of Monstera deliciosa.

The central conducting portion of the aerial root consists of alternating strands of xylem and phloem, with the vessels increasing in size towards the centre. These vascular strands are divided into groups of one or more large vessels surrounded by smaller ones. The elements of the protoxylem are spiral, and of the metaxylem the vessels are scalariform, while the contiguous vessels are provided with transverse pitted plates.

The ground tissue of this root is completely sclerosed, the cell walls being very thick and the markings well defined. An irregular row of from one to three cells deep of thick-walled pitted cells divides the outer cortex from the inner cortex. On the outside border of this layer there are cells rich in rhombohedral crystals of calcium oxalate.

The cortex is composed of large polyhehric cells; stellate crystals of calcium oxalate are scattered throughout, but they are more numerous towards the periphery. The fibrous hairs so common in the Aroideae are found in quantity in the intercellular spaces. Surrounding the cortex is the thin-walled cambial tissue from which the suberised layers are developed, and lastly there is the piliferous layer which persists in the adult roots (*cf.* Van Tieghem's description of the root of *Monstera repens* in his paper on "Structure des Aroïdées," Annales des Sciences Naturelles, sér. 5, tome vi, p. 147).

The adult roots of *Monstera deliciosa* grown in the other four media, soil, water, gravel, and damp soil, show the same general structure as the aerial root, but they differ in the

thickness of the walls of the sclerosed ground tissue and of the cells of the "multiple endodermis." The extent of thickening in both cases is progressively less, as in the order stated—

(1) Aerial.
(2) Damp soil.
(3) Gravel.
(4) Water } same.
(5) Soil }

In the cortex of the water-culture roots lacunae are found. Freidenfelt in "Der anatomische Bau der Wurzel," Bibliotheca Bot., 1904, p. 75, shows that an increase in the water content of the soil decreases the number of hairs found on the root. The piliferous layers of the roots cultivated in the different media vary. Aerial, soil, and gravel roots have practically the same quantity of hairs, but the respective average lengths are 1·25 mm., 1·15 mm., 1·08 mm. The hairs of the water roots are more numerous, but they are short, the average length being ·47 mm. The piliferous layer of the damp-soil roots is feebly developed, and the average length of the hair is ·5 mm.

Summary.

1. The development of the absorptive layer varies inversely with the humidity of the medium.

2. The development of the mechanical tissue varies directly with the humidity of the medium.

3. There is no variation, as one would expect, in the size of the intercellular spaces of the fundamental tissue, excepting the presence of lacunae in the cortex of the water roots.

EXPLANATION OF PLATE.

Monstera deliciosa.

Fig. 1. *T. S. root grown in water.*

(*a*) Multiple endodermis.
(*b*) Sclerosed ground tissue.
(*c*) Fibrous hair.
(*d*) Lacuna.

Fig. 2. *T. S. aerial root.*

Letters as in fig. 1.

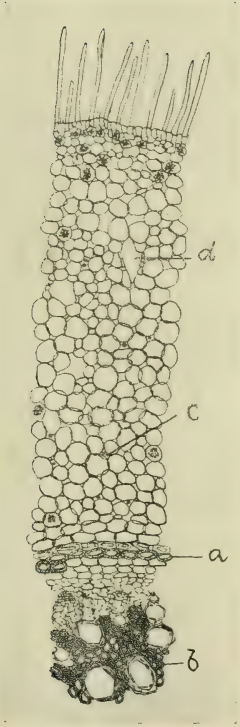


FIG. 1.

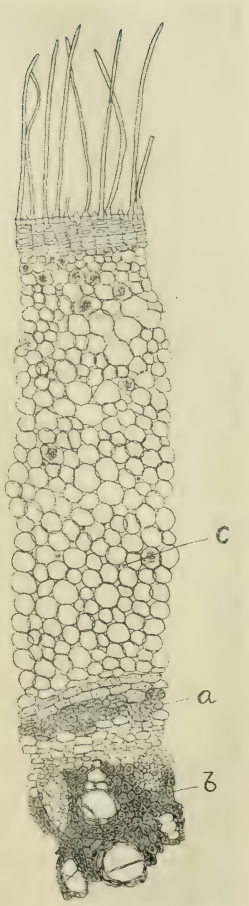


FIG. 2.

Rhododendron trichocladum, Franch., and its Allies.

By Professor Bayley Balfour, F.R.S.

(Read 13th April 1916.)

This is a small group of Western Chinese species characterised by deciduous leaves and small yellow precocious flowers. We know more or less of four species in the group—*Rh. trichocladum*, Franch., from the Tali Range; *Rh. mekongense*, Franch., from Mt. Sila on the Mekong-Salween divide; *Rh. melinanthum*, Balf. f. et Ward, from East Burma close to the Yunnan boundary, near Atuntsu; and *Rh. xanthinum*, Balf. f. et W. W. Sm., from the Shweli-Salween divide. Of these *Rh. trichocladum*, Franch., has flowered in cultivation from seeds collected by Forrest. From herbarium specimens I judge that *Rh. xanthinum*, Balf. f. et W. W. Sm., is the most desirable of the species from the horticultural standpoint.

In all the species the young parts are coated with an indumentum of long, somewhat tawny, hairs intermixed with the peltate scales of a lepidote surface. As elsewhere amongst Rhododendrons, the stalks of the scales are sunk in shallow pits of the laminar surface, but the disk of the scale is well outside the pit, and this allows its marginal series of cells to expand as a peripheral fringe. Here the component cells of the fringe remain in contact one with the other throughout their extent and do not branch, so that the fringe is entire. The hairs, which may be stiff and erect (*Rh. trichocladum*, Franch.) or lanate and interwoven (*Rh. xanthinum*, Balf. f. et W. W. Sm.), may persist on the twigs to the second year or longer, or may fall off early, and similarly the leaf may, except on the petiole and the base of the midrib above and below, lose entirely the hairs, but all stages of the shedding are to be met with. The under surface of the leaf in all the species is less markedly coated with wax than is the case in the small yellow-flowered species of the Brachyanthum group; indeed in *Rh. trichocladum*, Franch., one can hardly speak of the surface as having a "bloom." Correlated with this, the epidermal papillae, which carry the wax, are short and conical.

The general similarity in flower structure that marks the

group is the presence of few-flowered (3–5) umbels of small flowers with sulphur-yellow corollas. The corolla is shortly campanulate, always lepidote outside, and pubescent on the back of the tube inside. The lobes are large and apparently patent in full flower. The ten stamens, always shorter than the corolla, have large ovoid anthers, and the filaments of the posterior ones are white villous about the middle just at the top of the ovary, and thus form a pompon at the mouth of the corolla tube. The other stamens are shortly pubescent for a short distance from the base upwards. The ovary is always lepidote. The style, glabrous and decurved, expands into a lobulate stigma.

KEY TO THE SPECIES.

Hispid with long stiff hairs:
- Calyx lobes 5 mm. long, long ciliate. Corolla 2 cm. long lepidote outside. Style shorter than or equalling stamens . . . . . *trichocladum*
- Calyx lobes 4 mm. long, long ciliate. Corolla 1 cm. long lepidote outside. Style described as shorter than ovary? . . . . . *mekongense*

Lanate:
- Calyx lobes 2 mm. long scarcely ciliate. Corolla 2 cm. long lepidote outside. Style longer than stamens . *melinanthum*
- Calyx lobes 2 mm. long barbate. Corolla 2 cm. long lepidote and lanate outside. Style shorter than stamens . . . . . *xanthinum*

Rhododendron trichocladum, Franchet in Bull. Soc. Bot. Fr., xxxiii (1886), 234.[1]

Undershrub, branchlets of the year hairy with lutescent rigid setae. Leaves firmly chartaceous obovate, dark green above with adpressed strigose hairs and with scattered lutescent squamellae, pale beneath and more densely lepidote, also hirtellous on the midrib and margin as well as on the petiole with rigid setae. Flowers 3–4 fasciculate at the apex of the branchlets, pedicels elongate and patently

[1] *Rh. trichocladum.*—Fruticulus, ramis hornotinis setis rigidis lutescentibus hirtis. Folia firmiter chartacea, obovata, supra atrovirentia, pilis strigosis adpressis, squamulisque lutescentibus conspersa, subtus pallida magis dense lepidota et praeterea ad nervum medium, simul ac ad margi nem et petiolum setis rigidis hirtella. Flores 3–4, ad apicem ramulorum fasciculati, sulphurei, pedunculis elongatis simul et calycibus patentim villosis; calyx membranaceus ex viridi lutescens, lobis ovatis longe fimbriato-ciliatis; corolla glabra, tubo brevissimo, rotata fere 2 cent. diam.; stamina 10, filamentis brevibus ad medium hirtellis; ovarium dense lepidotum.

villous like the calyx. Calyx membranaceous, greenish lutescent with ovate long-fimbriate ciliate lobes. Corolla rotate sulphur-yellow glabrous, almost 2 cm. diam., tube extremely short. Stamens 10 with short filaments hirtellous at the middle. Ovary densely lepidote.

Yunnan:—On Mount Tsang-Chan. Delavay.

So much Franchet, l.c.

I add the following comments:—

The branchlets of the year have, in addition to the setae, scattered lutescent scales like the leaves. In their second year the branchlets have lost all or most of the hairs and are brownish in tint. The older branches are ash-grey. The foliage buds are ovoid, the bud scales brown leathery, all the outer ovate to ovate rounded—the outermost slightly pointed, those within more rounded and mucronulate, when expanded lepidote on back, and all are more or less shortly ciliate. The innermost become oblong or obovate and pass into foliage leaves. The young leaves often have an abundance of rigid setae on the upper surface. These always disappear early, and I find that the adpressed strigose hairs on the upper surface are not apparent elsewhere than on and about the midrib. The paleness of the under leaf-surface is due to the granular wax on the surface of the epidermal papillae, which here are very short and conical, but the layer never suffices to give the impression of waxy bloom such as one sees in *Rh. melinanthum*, Balf. f. et Ward, or in *Rh. sulfureum*, Franch. The peltate scales have an entire fringe, and the umbo is slightly convex and rubiginose. The pedicels are also lepidote. The flower bud scales are quite like those of the vegetative buds. The calyx lobes are often oblong, about 5 mm. long by 2 mm. broad. The sulphur-yellow corolla is about 2 cm. long with the lobe about 1 cm. wide or more, and the tube strongly pubescent inside on the posterior side. Of the ten stamens four posterior are villous about middle just above the ovary, the others are slightly pubescent from near base a short way upwards. The scales of the ovary have a fringe and are like those of the leaf. The short glabrous style is decurved. The ovary is ovoid, about 4 mm. long; the style is about 7 mm. long, expanding into the lobed stigma. The capsule is small ovoid oblong,

about 8 mm. long and 3 mm. broad, with vestiges of the squamules.

The dried specimens I have examined are :—

Yunnan :—Les coteaux de Tchang-chan. Alt. 3000 m. Delavay. Herb. Paris.

Yunnan :—Mekong-Yangtze divide. Moist open situations in pine forests on the ascent of the Wei Hsi pass. Lat. 27° 15′ N. Alt. 10,000 ft. G. Forrest. No. 698. Sept. 1904. Herb. Edin.

Yunnan :—Eastern flank of the Tali Range. Lat. 25° 40′ N. Alt. 9000–10,000 ft. Shrub of 2–4 ft. Foliage deciduous, flowers pale yellow. Open rocky situations in side valleys. G. Forrest. No. 4145. May–June 1906. Herb. Edin.

Yunnan :—Eastern flank of the Tali Range. Lat. 25° 40′ N. Alt. 10,000–11,000 ft. Shrub of 2–4 ft. Flowers bright yellow. In rhododendron and cane scrub. G. Forrest. No. 6755. June 1910. Herb. Edin.

Yunnan :—Tali Range. Lat. 25° 40′ N. Alt. 10,000–11,000 ft. Shrub of 2–4 feet. Flowers precocious, bright yellow. Open pasture on the margins of rhododendron thickets. G. Forrest. No. 11,630. July 1913. Herb. Edin.

Yunnan :—Tali Range. Lat. 25° 40′ N. Alt. 10,000–11,000 ft. G. Forrest. No. 12,423. May 1914. Herb. Edin.

I have also seen twigs of plants grown by Mr. Williams at Werrington, and we have in the Royal Botanic Garden several plants—some of them flowered in 1915—which were raised from seed collected by Mr. Forrest and presented to the Garden by Bees, Ltd. The plant is hardy and an interesting addition to our small yellow-flowered garden species. I notice that some of these living plants have not shed their leaves after the first season.

Mr. Forrest tells me the plant is abundant on the Tali Range.

Rhododendron mekongense, Franch. in Journ. de Bot. xii (1898), 263.[1]

[1] *Rhododendron mekongense*. (*Azalea* sensu Maxim.)—Rami virgati ramosi, in vicinitate inflorescentiae simul ac ramuli novelli pilis longis hispidi ; folia post flores evoluta (adulta non vidi), juvenilia oblongo-obovata, 15–25 cent. longa, petiolo et ad marginem hirsuta, apice rotundata cum mucronulo, supra intense viridia, glabra, subtus glauca,

Branches virgately branched, hispid with long hairs in the vicinity of the inflorescence and also on the young branchlets. Leaves (which are not known in the mature state) expanding after the flowers; young leaves oblong obovate, 15–25 mm. long, hirsute at the margin and on the petiole; apex rounded and mucronulate, deep green glabrous above, glaucous beneath and lepidote. Floral buds separated from the foliar buds small (4–5 mm.) glabrous. Flowers terminal, 3–5, loosely fasciculate; pedicels 10–12 mm. long lepidote. Calyx 4 mm. long with lanceolate obtuse lepidote lobes ciliate at the margin with fuscous hairs. Corolla yellow, 1 cm. long, 12 mm. wide, shortly and widely tubular with obovate cup-shaped lobes; stamens 8–10 included, filaments lanate below. Ovary closely lepidote, longer than the glabrous style.

Mt. Sila in the Mekong Valley, between the Mekong and the Salween. Soulié.

The corolla is like that of *Rh. brachyanthum*, Franch., but the calyx has a different form, and the presence of hairs upon the branches and upon the leaves and the precocity of the flowers in *Rh. mekongense*, Franch., distinguish well the two species.

So much Franchet l.c.

I add the following comments :—

This species, imperfectly known, is a difficult one. Through the kindness of M. Lecomte I have seen a specimen of Soulié's collecting under No. 1004 from the locality of the type. I have made a careful analysis of this specimen and find no character by which I can separate it from *Rh. trichocladum*, Franch. Without doubt they are the same species. In a note to his description of *Rh. mekongense*, Franchet compares his species with *Rh. brachyanthum*, Franch., and from that species Soulié's plant is easily diagnosed on the lines marked out by Franchet. But it is remarkable that Franchet says

lepidota ; gemmae florales at foliaccis sejunctae, parvae (4–5 mm.), glabrae ; flores terminales laxe fasciculatae, circiter 3–5, luteae ; pedunculi 10–12 mm. lepidoti ; calyx 4 mm., lobis lanceolatis, obtusis, lepidotis, margine pilis fuscis ciliatis ; corolla 1 cent. longa, 12 mm. lata, breviter et late tubulosa, lobis obovatis, poculiformibus ; stamina 8–10, inclusa, filamentis inferne lanatis ; ovarium crebre lepidotum, stylo glabro longius.

nothing about *Rh. trichocladum*, Franch., as an ally of *Rh. mekongense*, Franch.

In 1906 I endeavoured to match Forrest's specimen No. 698—this is the same as Monbeig No. 7 in Kew Herbarium: so like are they they might have been plucked from the same bush—with specimens named by Franchet in the Paris Herbarium, and found the match in a specimen named *Rh. mekongense*, Franch., without entering into a critical investigation of distinction from *Rh. trichocladum*, Franch. Now having good material of *Rh. trichocladum*, Franch., both dried and living specimens of Forrest's and dried ones of Monbeig's plants, I am satisfied that they do not differ from *Rh. trichocladum*, Franch. This adds, I think, to the evidence pointing towards the identity of *Rh. mekongense*, Franch., with *Rh. trichocladum*, Franch.

Turning now to the words of the technical description of the two species *Rh. trichocladum*, Franch., and *Rh. mekongense*, Franch. (the adult leaves of *Rh. mekongense*, Franch., are unknown), the only characters available for distinction are:—

a. The corolla cup-shaped, 1 cm. long in *Rh. mekongense*, Franch.; rotate and 2 cm. long in *Rh. trichocladum*, Franch.

b. The ovary longer than the style in *Rh. mekongense*, Franch.; shorter in *Rh. trichocladum*, Franch.

Short corollas occur, however, in *Rh. trichocladum*, Franch., and its rotateness is often hardly marked—easily merging into cup-shaped.

As to the relative length of the ovary and style Franchet writes, "ovarium crebre lepidotum, stylo glabro longius." This would be an unusual character in this series of Rhododendrons—though it is met with in the Lapponicum group and in the Anthopogon group—and I suspect a misprint: perhaps we should read, "stylo glabro longissimo." The character named by Franchet does not appear in Soulié's specimen No. 1004.

What I have said about its relationship with *Rh. trichocladum*, Franch., does not end my difficulty over *Rh. mekongense*, Franch. Kingdon Ward collected in the Kagwr-pw glacier valley, which is near Atuntsu, a pretty

yellow-flowered species which now bears the name *Rh. melinanthum*, Balf. f. et Ward. The locality is not far from Mt. Sila, where Soulié obtained *Rh. mekongense*, Franch., and I have tried to see in Ward's plant Franchet's species. The characters of *Rh. melinanthum*, Balf. f. et Ward, are quite definite, separating it readily from *Rh. trichocladum*, Franch., and its short calyx, longer pedicels and long projecting style do not fit in with Franchet's description of *Rh. mekongense*, Franch.

Until more material is available we must leave the question where it stands.

Rhododendron melinanthum, Balf. f. et Ward.[1] Sp. nov.

A bushy shrub, 6–8 ft. high, with slender scarcely twiggy branches and leaves deciduous after one season. Branchlets of the year are about 1 mm. in diam., clad with long setae

[1] *Rhododendron melinanthum*, Balf. f. et Ward.—Frutex circ. 2–2·5 m. altus tenuiramosus vix virgatus. Ramuli hornotini circ. 1 mm. diam. pilis setiformibus plus minusve praediti et squamulis peltatis rufis perpaucis intermixtis obsiti annotini glabri albidi. Alabastra ovoidea parvula cataphyllis externis ovatis spadiceis circ. 1 mm. longis glabris intermediis spadiceis oblongis circ. 7 mm. longis acutis vel obtusis vel subtruncatulis extus lepidotis internis submembranaceis vel subfoliaceis lepidotis. Folia parva brevissime petiolata ad 4·5 cm. longa; lamina anguste obovata vel oblanceolata circ. 4 cm. longa 1·5 cm. lata chartacea apice subrotundo-obtusa minute mucronulata margine plana basi cuneata supra laete viridis costa media tenui minutissime puberula venulis primariis delicatis utrinsecus ad 6 ultimisque (siccitate) leviter elevatis ubique minutissime granulosa subtus glauca papillis epidermicis ceriferis obtecta lepidota squamulis peltatis inaequalibus integro-marginatis conspersis epilosa vel margine et pagina inferiore pilis setiformibus sparsissimis praedita (juventute hirsuta). Inflorescentia terminalis umbellata plerumque 4-flora. Flores plus minusve praecoces. Bracteae mox deciduae (non visae). Pedicelli circ. 1·5 cm. longi tenues stricti sparse lepidoti nunc etiam pilis longis hirsuti. Calyx parvulus lobis 5 ovatis vel deltoideis ad 2 mm. longis glaberrimis vel lepidotis rarissime pilis paucis fimbriatis. Corolla lutea extus sparsim lepidota epilosa breviter campanulata vel subpoculiformis circ. 2 cm. longa tubo 1 cm. longo intus puberulo limbi ampliati lobis 5 rotundatis circ. 1 cm. latis. Stamina 10 inaequalia corolla breviora filamentis paucis posterioribus fere ad apicem albo-villosis caeteris basin versus puberulis. Ovarium anguste ovoideum circ. 5 mm. longum dense lepidotum; stylus ultra corollam exsertus ad 2 cm. longus glaberrimus; stigma lobulatum.

Species burmanica ex affinitate *Rh. trichocladi*, Franch. et *Rh. mekongensis*, Franch. ab hoc pilis lanatis non hispidis, pedicellis longioribus, ovario angustiore, stylo corollam superante, ab illo foliis longioribus angustioribus pagina superiore haud strigoso-puberula inferiore glauciore papillis ceriferis longioribus, pedicellis duplo longioribus, calycis lobis parvis haud hirsutis, corolla haud rotata, stylo duplo longiore longe exserto.

and a few peltate reddish scales: the whitish one-year-old branches have neither hairs nor scales. Leaf buds are small and ovoid, covered by chestnut-brown oblong pointed or blunt scale-leaves, which are more or less lepidote on the outside. Leaves small, very shortly stalked, at most 4·5 cm. long; blade narrowly obovate or oblanceolate, at most 4 cm. long and 1·5 cm. broad, thin, papery, blunt, somewhat rounded at the apex, minutely mucronulate with a flat margin and cuneate base, bright green on the upper surface without hairs except for a few minute ones over the midrib (which is slender and slightly prominent, as are the primary veins, which are about 6 on each side, and also the ultimate branches of the venation at least in the dried state), on the under side showing a glaucous wax bloom not very white and lepidote with discontiguous peltate unequal superficial scales which have an entire fringe; the whole leaf devoid of setae except perhaps for a few on the margin and under surface, the remains of a dense covering in youth. Inflorescence a terminal umbel of about 4 flowers, which expand before the leaves. Bracts falling off early. Pedicels about 1·5 cm. long, stiff, slender, and sparingly lepidote, occasionally setulose also. Calyx small with 5 ovate or deltoid lobes about 2 mm. long, without hairs or scales or rarely with a few. Corolla yellow, sparingly lepidote outside but without hairs there, about 2 cm. long, shortly campanulate or somewhat cup-shaped, expanding into a spreading limb with a tube 1 cm. long, puberulous inside and 5 rounded lobes each about 1 cm. broad. Stamens 10 unequal, shorter than the corolla with large ovoid anthers and the posterior filaments densely girt with white hairs about the middle and just above the ovary, the other stamens being shortly puberulous near the base only. Ovary ovoid, about 5 mm. long, densely lepidote; style longer than corolla, about 2 cm. long, quite glabrous and slightly declinate, stigma lobulate.

E. Upper Burma:—Ka-gwr-pw glacier valley. Abies forest. Alt. 12,000–14,000 ft. Kingdon Ward. No. 406. June 1913. Flowers large yellow. Bushy shrub of 6–8 ft.

A bright-flowered species which should be worthy of cultivation. It is easily distinguished from *Rh. trichocladum*, Franch., by its larger adult leaves without hairs

on the upper surface, by the more glaucous tint of the under surface of the leaf where the epidermal papillae are longer, by the flower pedicels nearly twice as long, by its small calyx, which is not hirsute, and by the much longer exserted style. Of its relations to *Rh. mekongense*, Franch., I have written under that species.

Rhododendron xanthinum, Balf. f. et W. W. Sm.[1] Sp. nov.

Small shrub about 1·5 meters high, with short twisted branches and leaves deciduous after one season. Branchlets of the year clad with twisted long interlocking hairs and also sparingly lepidote; one-year-old branches grey and without hairs or scales. Leaf buds small oblong ovoid, the bud scales all shortly ciliate at the apex and the inner lepidote on the back. Leaves at most 3 cm. long, appearing after the flowers; blade thin papery, at most about 2·7 cm. long and 7 mm. wide, oblong or narrowly obovate obtuse or somewhat rounded or even acute at the apex with a flat

[1] *Rhododendron xanthinum*, Balf. f. et W. W. Sm.—Fruticulus ad 15 dm. altus tortuose breviterque ramosus. Ramuli hornotini pilis lanatis dense vestiti sparsimque lepidoti annotini glabri grisei. Alabastra parva oblongo-ovoidea cataphyllis brunneis exterioribus subrotundatis apice breviter ciliatis interioribus oblongis obtusis circ. 6 mm. longis extus plus minusve lepidotis apice ciliatis. Folia post flores evoluta ad 3 cm. longa; lamina tenuis chartacea circ. 2·7 cm. longa 7 mm. lata oblonga vel anguste obovata apice obtusa nunc subrotundata nunc subacuta margine plana basi cuneata supra sordide viridis subtus pallidior utrinque juventute pilis lanatis fuscis squamulisque superficialibus peltatis integro-fimbriatis lutescentibus discontiguis subtus densius obtecta maturitate supra pilis squamulisque paucis sparsa nunc omnino glabra infra semper lepidota sed costa media basi excepta fere epilosa venarum reticulo purpurascente; petiolus ad 4 mm. longus dense lanatus et plus minusve lepidotus. Flores in umbellam terminalem circ. 3-floram dispositi praecoces; bracteae non visae; pedicelli circ. 1·3 cm. longi lanati et lepidoti superne in calycem lanato-barbatum expansi. Calyx pilis lanatis occultus lobis 5 circ. 2 mm. longis. Corolla lutea circ. 2 cm. longa anguste campanulata extus pilis lanatis plus minusve obtecta et lepidota, tubo circ. 1 cm. longo intus pubescente, limbi ampliati lobis 5 rotundatis circ. 1 cm. diam. integris patentibus. Stamina 10 corolla breviora filamentis posterioribus medium versus albo-villosis os corollinum oppletentibus anterioribus basin versus plus minusve pubescentibus. Ovarium ovoideum circ. 3 mm. longum lepidotum et pilis lanatis ad apicem praecipue plus minusve obtectum; stylus circ. 8 mm. longus stamina subaequans declinatus glaber; stigma lobulatum.

Species yunnanensis *Rh. trichoclado*, Franch. persimilis ramulis brevibus subintricatis haud virgatis, foliis angustioribus, calyce lanato barbato, corolla extus pilis lanatis obtecta differt.

margin and cuneate base, dull green above, paler beneath but without marked glaucous bloom, when young clad on both sides, but more densely below, with long intricate pale brownish hairs and also lepidote with pale shining superficial discontiguous scales; older leaves have lost more or less the hairs and scales from the upper side and are lepidote below with some hairs on the base of the midrib and covering the petiole—the midrib and primary veins and the veinlets tend to become a dark red colour and are not prominent; petiole, at most 4 mm. long, is densely coated with long intricate hairs and more or less lepidote. The flowers are grouped in terminal umbels of about 3 flowers and are precocious. Bracts are soon deciduous. Pedicels are at most 1·3 cm. long with hairs and scales, and expand into the calyx, which is so densely bearded its surface is hidden. Calyx lobes 5. Corolla yellow, about 2 cm. long, narrowly campanulate lepidote outside and pilose; the tube is about 1 cm. long and is pubescent inside, the ample limb has 5 rounded spreading entire lobes about 1 cm. in diameter. The stamens are 10 shorter than the corolla with large ovoid anthers, and the filaments of the posterior stamens whitely villous about the middle, filling up the mouth of the corolla above the ovary, the others are puberulous at the base. The ovoid ovary, about 3 mm. long, is lepidote and also bears long twisted hairs, especially at the top; style more or less declinate is about 8 mm. long and quite glabrous; stigma lobulate.

Yunnan:—Shweli-Salween divide. Lat. 25° 30′ N. Alt. 10,000 ft. Shrub of 2–4 ft. Flowers precocious, canary-yellow. Open stony slopes on the margins of thickets. G. Forrest. No. 12,066. June 1913.

This species is without doubt the representative on the Shweli-Salween divide of *Rh. trichocladum*, Franch., which is spread over the Tali Range. The Shweli-Salween plant differs from *Rh. trichocladum*, Franch., in habit. It forms a somewhat intricately branched small shrub wanting the stouter virgate twigs of *Rh. trichocladum*, Franch. Then the hair indumentum here is always lanate in type, not hispid. Further, the calyx has a dense beard of hairs coating it, and the corolla has hairs on the outside in addition to scales.

New Garden Dracocephalums from China. By W. W. Smith, M.A., and George Forrest.

(Read 13th April 1916.)

During the last two years further botanical material has been obtained in the rich alpine regions of North-West Yunnan, and amongst this material (as yet but inadequately examined) are certain interesting new Dracocephalums with pinnatifid leaves, some of which are already in cultivation and will prove of undoubted horticultural value. Previous to the discovery of these, only one pinnatifid-leaved member of this genus was recognised as being Chinese—*D. tanguticum*, Maxim.,—and in the recently published Key to the Labiatae of China (S. T. Dunn, B.A., F.L.S., in Notes R.B.G. Edin., vi, 127) that species is separated from its Chinese allies by its pinnatifid leaves. Moreover, all the Kansu, Szechuen, and Yunnan sheets with such leaves are referred to that species. We have previously acquiesced in this arrangement, which we saw no good reason to dispute, supported too as it was by both Professor Diels and Mr. Dunn, authorities on the Flora of China of the highest standing. But further experience in the field and acquaintance with the plants under cultivation have forced us to the conclusion that *D. tanguticum* is an aggregation of very distinct plants which in gardens would be looked upon as meriting definite specific names. As regards the Yunnan species of the group, observation in the field with the discovery of new allies strongly supports this conclusion. Garden experience of the newer plants points in the same direction.

It was the discovery of *D. Isabellae* (described by one of us in Notes R.B.G. Edin., viii, 211) which first suggested the possibility of a series of closely allied species of the *D. tanguticum* type. This very beautiful species was found on the Chungtien plateau, and is now in cultivation. It possesses leaves almost identical with those of *D. tanguticum*, but its magnificent flowers have distinct characters of their own. Then followed a small-flowered species which is described below as *D. propinquum*; in habit and

inflorescence it is further removed from the Kansu plant of Przewalski (type of *D. tanguticum*) than is the Yunnan plant cultivated in this country under *D. tanguticum*. It is in cultivation, and its behaviour there is all in favour of its specific distinctness; in the form of the leaves and in the structure of the flower its *tanguticum* affinity is undoubted, yet no observer at first sight would imagine them to be even closely related. This dissimilarity led us then to doubt the correctness of the view which associated the Yunnan "*D. tanguticum*" with the typical Kansu plant. The Yunnan plant has a distinct habit which is definite even in the first year's growth; its flowers are twice the size of those of the Kansu plant—worthy of note, although we would not attach much weight to that character if it stood alone. The plant ought to have a distinguishing name, and as on its first appearance in the Royal Botanic Garden as a cultivated plant it bore for a while the name *D. Forrestii*, we propose to restore that appellation. A diagnosis is given below.

Another plant of the series is found on the Tali Range, more closely allied, in our opinion, than any of the others to the Kansu *D. tanguticum*. It is described below as *D. taliense*. Its area of distribution is in the Mekong basin, separated by a long and very high mountain range from the habitats of the other Yunnan species. Of these *D. Isabellae* and *D. propinquum* appear to be confined to the Chungtien plateau; *D. Forrestii*, at its optimum in the Lichiang Range, has outliers on the same plateau.

In our view then there are five species of this section with pinnatifid leaves known from China. Two have very large flowers, *D. Isabellae*, *D. Forrestii*; *D. tanguticum*, flowers of moderate size; *D. propinquum*, *D. taliense*, flowers decidedly smaller than those of the other species. In the Royal Botanic Garden during 1915 three of these were in flower—*D. Forrestii*, *D. Isabellae*, *D. propinquum*; the differences between them are manifest both in the early and in the late stages of development.

Dracocephalum Forrestii, W. W. Sm. Sp. nov.

Species valde affinis *D. tanguticae*, Maxim. sed habitu,

inflorescentia vix interrupta potius densissima, verticillastris paucifloris, calycibus majoribus divergit.

Herba perennis 15–50 cm. alta caulibus gracilibus simplicibus vel ramosis dense foliatis plus minusve albo-villosulis internodis ±1 cm. longis. Folia 2–3-jugo-pinnatisecta vel 3-partita segmentis linearibus usque ad 2 cm. longis 1 mm. latis acutiusculis revolutis supra glabris nitentibus infra praesertim in costam albo-villosulis; folia in cultura aeque revoluta, nonnunquam subplana. Verticillastri saepius 2–4-flori numerosi 10–30, apice fere ad basim caulis orientes approximati inflorescentiam densam spiciformem bracteis magnis et calycibus purpureis ornatam formantes. Bracteae foliis subsimiles subaequales; bracteolae subulatae vel lineares calyce multo breviores; pedicelli 1–3 mm. longi. Calyx ±2 cm. longus anguste tubulosus dense albo-villosulus purpurascens; dentes ±7 mm. longi anguste lanceolati subspinescentes superiores paulo majores. Corolla ±3 cm. longa saturate purpureo-coerulea extus densius intus hic illic albo-villosula; tubus basi 2 mm. latus superne ventricoso-ampliatus 5–6 mm. latus; labium superum obovatum galeatum 5–6 mm. longum emarginatum; labium inferum patens ±1 cm. longum lobo medio reniformi circ. 5 mm. lato lobis lateralibus subrotundatis multo minoribus. Stamina e tubo exserta filamentis longiuscule albo-villosis antheris glabris. Nuculae circ. 3 mm. longae trigono-oblongae compressiusculae minute papillosae glabrae nigrae.

Dracocephalum tanguticum, Diels, vix Maxim. in Notes Roy. Bot. Gard. Edin., vii (1912), pp. 45, 187; Dunn, ibid., vi (1915), 168.

"Flowers deep blue. On dry grassy banks on the Chungtien plateau between descent of Niu Chang Pass and Hsia Chung Tien, Yunnan. Alt. 12,000–13,000 feet. Sept. 1904." G. Forrest, No. 605.

"Plant of 12–16 inches. Flowers deep blue. Whole plant aromatic. Open dry situations amongst scrub on the eastern flank of the Lichiang Range, N.W. Yunnan. Lat. 27° 25′ N. Alt. 11,000 ft. Sept. 1906." G. Forrest, No. 3033.

"Plant of 6–10 inches. Flowers deep purplish-blue. Stony mountain meadows on the eastern flank of the

Lichiang Range. Lat. 27° 30′ N. Alt. 11,000–12,000 ft. Aug. 1910." G. Forrest, No. 6490.

Also Nos. 604, 11,297 from the Chungtien plateau, and No. 10,978 from the Lichiang Range.

Dracocephalum propinquum, W. W. Sm. Sp. nov.

Species affinis *D. tangutico*, Maxim. sed habitu ramoso verticillastris paucifloris floribus multo minoribus inter alia differt.

Herba perennis 30–45 cm. alta caulibus gracilibus basi ad apicem ramosis plus minusve albo-villosulis internodis 2–3 cm. longis. Folia variabilia, juvenilia saepe simplicia linearia circ. 1·5 cm. longa, seniora 2–3-jugo-pinnatisecta vel 3-partita segmentis linearibus 1 mm. latis acutiusculis revolutis supra glabris nitentibus infra praesertim in costam albo-villosulis; folia in cultura saepe plana 2 mm. lata. Verticillastri 1–2-flori, rarius 3–4-flori, in suprema parte caulis orientes satis remoti inflorescentiam spiciformem circ. 15 cm. longam formantes; rami aeque floribundi. Bracteae foliis subsimiles minores, simplices lineares vel tripartitae; bracteolae subulatae vel lineares calyce multo breviores; pedicelli ±1 mm. longi. Calyx 6–8 mm. longus anguste tubulosus albo-villosulus purpurascens; dentes 2–3 mm. longi lineari-lanceolati subspinescentes superiores paulo majores. Corolla 13–14 mm. longa violaceo-purpurea extus sparse albo-villosula; tubus basi 1 mm. latus superne ventricoso-ampliatus 3–4 mm. latus; labium superum obovatum galeatum 3–4 mm. longum emarginatum; labium inferum patens circ. 5 mm. longum lobo medio reniformi 5 mm. lato emarginato lobis lateralibus subrotundatis multo minoribus. Stamina e tubo exserta filamentis sparse villosis antheris glabris. Nuculae circ. 3 mm. longae trigono-oblongae compressiusculae minute papillosae glabrae nigrae.

"Plant of 12–18 inches. Flowers soft violet purple. Open stony pasture on the mountains in the N.E. of the Yangtze bend, Yunnan, West China. Lat. 27° 45′ N. Alt. 10,000 ft. Sept. 1913." G. Forrest, No. 11,195.

Also cultivated in Royal Botanic Garden, Edinburgh, from seed presented by J. C. Williams, Esq., Caerhays Castle, Cornwall.

Dracocephalum taliense, G. Forrest. Sp. nov.

Species valde affinis *D. tangutico*, Maxim. a quo habitu diverso, caulibus supra ramosis paucifloris, verticillastris 1–2-floris regione foliata haud discretis eacumque ± intermixtis inter alia recedit.

Herba perennis 45–60 cm. alta caulibus gracilibus infra simplicibus | supra medium ramosis ramulis ascendentibus bene foliatis paucifloris. Folia 2–3-jugo-pinnatisecta segmentis linearibus usque ad 2·5 cm. longis 1 mm. latis acutis revolutis supra glabris subnitentibus infra ad costam prominentem albo-villosis. Verticillastri saepius 1–2-flori pauci vulgo 4–5 inflorescentiam laxam spiciformem (terminalem sed una cum regione foliata intermixtam) haud conspicuam formantes. Bracteae foliis simillimae; pedicelli fere nulli. Calyx ±1·2 cm. longus tubulosus mediocriter albo-villosulus viridis vel supra purpurascens; dentes 3–4 mm. longi triangulari-lanceolati subspinescentes. Corolla ±2 cm. longa saturate purpurea extus dense intus sparse albo-villosa; tubus supra ventricoso-ampliatus, labium superum circ. 3 mm. longum emarginatum, inferum circ. 5 mm. longum lobo medio reniformi. Stamina e tubo exserta filamentis albo-villosis. Nuculae maturae desunt.

"Plant of 1½–2 ft. Flowers deep soft purple, open dry situations amongst pine scrub and on ledges of cliffs on the western flank of the Tali Range, Yunnan. Lat. 25° 40′ N. Alt. 10,000 ft. Aug. 1913." G. Forrest, No. 11,524.

This species differs much less from the Kansu plant than the allied species do.

Note on Parasyringa, a New Genus of Oleaceae.

By W. W. Smith, M.A.

(Read 10th February 1916.)

In 1886 Franchet described under *Syringa sempervirens* a peculiar Yunnan plant and found it necessary to extend the scope of the genus *Syringa* for the accommodation of his new species. This he did by making a new section

Sarcocarpion, of which *Syringa sempervirens*, Franch., is the sole representative. Several characters of the new species accord ill with *Syringa*—the evergreen coriaceous foliage, the more or less fleshy mesocarp of the fruit, and the single wingless seed. The habit of the plant, moreover, does not suggest *Syringa*; so little is it reminiscent of that genus that anyone unacquainted with the plant would compare it with *Ligustrum* and its allies in his first attempt at identification. These difficulties have already been noted by Schneider in his Illustriertes Handbuch der Laubholzkunde, vol. ii, p. 771, from which I quote his apt note:—"Die *S. sempervirens*, Franchet, in Bull. Soc. Linn. Paris, i. 613, 1886, aus Yunnan, mit immergrünen B. und steinfruchtartiger Fr. mit etwas fleischigem Mesocarp und ungeflügelten Samen kenne ich nur aus einem Bl.-Exemplar, das viel mehr einem *Ligustrum* als einer *Syringa* gleicht. Franchet begründete auf diese Art seine Sekt. *Sarcocarpion*. Meiner Meinung nach handelt es sich hier wohl um eine neue Gattung, doch konnte ich die Fr. noch nicht untersuchen."

The resemblance to the genus *Ligustrum* is well illustrated by the marked similarity in habit and leaves to *Ligustrum coriaceum*, Carr., an excellent figure of which is given in Bot. Mag., tab. 7519. The native country of this latter plant is not definitely known—it is possibly Japan; by many good authorities the plant is considered merely a growth form of *L. japonicum*, Thunb., which has arisen in Japanese gardens. However that may be, the resemblance is so close that Mr. George Forrest (collector of the sheets quoted below) was at first sight inclined to believe that plants of the latter growing in the Royal Botanic Garden, Edinburgh, were the same as the Yunnan plant known to him. The fruits, however, of the two plants are quite distinct, that of *L. coriaceum* being a globose berry, the size of a small pea, that of the Yunnan plant oblong and dehiscing from the apex.

The plant is then somewhat awkwardly placed in *Syringa*, although nearly allied: its dehiscent fruit separates it readily from *Ligustrum* and other members of the *Oleineae*. I suggest as the generic name *Parasyringa*. Franchet's sectional name would be appropriate, but that name, with

a slightly different suffix, is, as Franchet himself points out, a synonym of *Kadsura*.

Parasyringa, W. W. Sm. Genus novum.

Calyx cupuliformis dentibus 4 brevissimis praeditus. Corolla tubulosa tubo calycem 2–3-plo superante, lobis 4 calyci subaequilongis induplicato-valvatis. Stamina 2 supra medium tubum affixa filamentis antheras aequantibus; antherae oblongae paululo exsertae medio dorso insertae. Ovarium 2-loculare; stylus ovario subduplo longior, stigmate breviter bifido; ovula in quoque loculo 2 ab apice loculi pendula. Drupa oblonga subteres mesocarpio tenui loculis inaequalibus altero casso altero abortu monospermo, apice dehiscens. Semen solitarium pendulum haud compressum exalatum; albumen carnosum; cotyledones planae radicula brevi supera. Fruticulus glaber. Folia opposita integra coriacea persistentia. Flores in paniculas terminales densas dispositi. Species unica yunnanensis.

Parasyringa sempervirens, W. W. Sm. Comb. nov.

Syringa sempervirens, Franch., in Bull. Soc. Linn. Paris, i (1886), 613; Hemsl., in Journ. Linn. Soc., xxvi (1889), 84; Diels, in Notes R. B. G. Edin., vii (1912), 116, 149, 257; Schneider, Handb. Laubholz., ii (1911), 771.

As the original description of the species is not in a readily accessible publication, I reproduce below Franchet's diagnosis:—

Sectio: *Sarcocarpion* (*Sarcocarpon* Bl. est *Kadsurae* synon.).—Fructus drupaceus, mesocarpio rupto loculicide dehiscens; loculis valde inaequalibus: altero casso, ovulis abortientibus; altero rite evoluto, abortu monospermo: semen oblongum, vix compressum, exalatum, incurvum. Frutex sempervirens, foliis coriaceis. Species hucusque cognita unica, infra descripta.

Syringa (*Sarcocarpion*) *sempervirens*, sp. nov.—Frutex bimetralis, ex toto glaber, ramosus, ramis, hornotinis angulatis, lenticellosis; folia breviter petiolata, limbo (1–1½ poll. longo) rigide coriaceo, late ovato vel suborbiculato, integerrimo, margine revoluto; cymae pauciflorae, secus ramos patentes paniculam terminalem pyramid-

atam efficientes: pedicelli inaequilongi (2–4 mill.), crassi; calyx cupuliformis obsolete crenatus; corolla alba tubulosa, tubo breviusculo (6–8 mill.) calyce subtriplo longiore, lobis demum reflexis, crassis, subobtusis; stamina circiter e medio tubi orta, antheris medio dorso insertis, oblongo-linearibus, corollam subaequantibus; stylus apice breviter bifidus: capsula drupacea, sub maturitate caerulescens, ovata, 12–15 mill. longa, semen unicum fovens.

Yun-nan, in montibus supra Tapintze, alt. 2500 m., legit *Delavay*.

The following sheets of the species are in the Herbarium of the Royal Botanic Garden, Edinburgh :—

"Dwarf shrub of 1–2 ft. Flowers creamy-yellow, fragrant. Dry shady situations on the margins of pine forests on the eastern flank of the Lichiang Range, Yunnan. Lat. 27° 30′ N. Alt. 12,000 ft. July 1910." G. Forrest, No. 6197.

"Evergreen shrub of 4–6 ft. Flowers immature, probably yellowish-white. In open shrub on the descent to the Yangtze from the eastern boundary of the Lichiang valley. Lat. 27° 15′ N. Alt. 9000–10,000 ft. June 1913." G. Forrest, No. 10,124.

"Evergreen shrub of 6–9 ft. Foliage coriaceous. Flowers pale creamy-yellow, fragrant. Open scrub and in thickets in the mountains in the N.E. of the Yangtze bend, Yunnan. Lat. 27° 45′. Alt. 8000–9000 ft. Aug. 1913." G. Forrest, No. 10,735.

"Shrub of 3–5 ft. In fruit. Open situations amongst scrub on the Yung-pe mountains, Yunnan. Lat. 26° 45′ N. Alt. 9000 ft. Sept. 1913." G. Forrest, No. 11,042.

I should add that young plants grown from seed (Forrest, No. 11,042), the gift of J. C. Williams, Esq., Caerhays Castle, Cornwall, are now in the Royal Botanic Garden. If, however, the rate of growth corresponds to that of *Ligustrum coriaceum*, Carr. (which in habit it so closely resembles), it will be some considerable time before it reaches the flowering stage.

Rhododendron lacteum, Franch. By Professor Bayley Balfour, F.R.S.

(Read 13th April 1916.)

Within the last few years there has flowered in cultivation in Europe a beautiful Chinese Rhododendron bearing the name *Rh. lacteum*, Franch. It is one of the large-leaved plants of the genus, is hardy, and produces a big truss of white flowers blotched with crimson. It was discovered in Yunnan by the Abbé Delavay, and from seeds sent by him to the Jardin des Plantes, Paris, the plants now flowering have originated. The first record of its flowering in Britain was in 1910 in the garden of Mr. F. D. Godman, South Lodge, Horsham. In France it first flowered with M. de Vilmorin at Verrières le Buisson in 1912, the flowering plant being then twenty-two years old.[1] Unfortunately the wrong name has got attached to the plant. It is not *Rh. lacteum*, Franch.[2] and the aim of this communication is to put right the nomenclature.

In 1886[3] Franchet described under the name *Rh. lacteum*, Franch. one of the first of many new Rhododendrons found by the Abbé Delavay on the Alps of Yunnan. The description runs:—

"Arbor. Folia crasse coriacea, ovato-elliptica, basi distincte cordata, supra intense viridia glabra, subtus pube pallide rufescente obducta, quasi tomentella, nervis utrinsecus 10–12. Flores 12–20 dense congesti, lactei, pedunculo elongato breviter rufo-lanuginoso; calyx minimus, dentibus obsoletis, late triangulis; corolla pollicaris, e basi late campanulata, extus glaberrima, lobis 6; stamina 12, filamentis basi scabridis; ovarium breviter et dense rufo-tomentellum, stylo ex toto glaberrimo.

"Yunnan, in monte Koua-la-po silvas efficiens. (Delavay, No. 164.)"

The full story on Delavay's ticket is:—"No. 164. Arbre

[1] See Mottet in Rev. Hort. (1912), 275; id. in Gard. Chron., Nov. 27, 1915. In the Botanical Magazine (1911), t. 8372, there is an error in the statement that it flowered with M. de Vilmorin in 1908.

[2] A short note stating this has appeared in the Gardeners' Chronicle of March 25, 1916.

[3] Franchet in Bull. Soc. Bot. France, xxxiii (1886), 231.

de 10 mètres. Fleurs blanc de lait. Forêt des hautes montagnes; forme presque à lui seul des forêts au sommet de Koua-la-po (Hokin). 21 Mai 1884. Leg. ipse Delavay."

In 1887[1] Franchet described under the name *Rh. lacteum*, Franch. var. *macrophyllum* another of Delavay's Rhododendrons in the following terms:—

"Folia ovato-oblonga, longe cuneiformia, usque ad 9 poll. longe subtus dense rufo-lanuginosa, flores usque 20–25 glomerato-corymbosi, corolla 4–5 cent. longa, lactea cum maculis fuscis.

"Yunnan ad collem Yen-tze-hay. Alt. 3200 m. ubi silvas efformat; fl. 23 maj. (Delav. No. 2214)."

The full story on Delavay's ticket is:—"No. 2214. Fleurs blanches avec une légère teinte lactée. Arbre de 8 à 10 mètres. Les forêts au col de Yen-tze-hay (Lankong) à 3200 m. d'alt. 31 Mai 1886. Legit Delavay."

I am under special obligation to M. Lecomte, Director of the Botanical Department in the Jardin des Plantes, Paris, for having given me the privilege of examining Franchet's type specimens (Delavay's Nos. 164 and 2214) preserved at Paris, and from them I have transcribed above Delavay's original tickets. In addition to these type specimens M. Lecomte has been so good as to send me a third sheet of specimens collected by Delavay and named *Rh. lacteum*, Franch. on the sheet by Franchet. Delavay's ticket on this specimen reads:—"Rhododendron No. 2794. Fleur jaune soufre. Arbrisseau de 2 mètres parmi les broussailles sur le Tsong-chan au-dessus de Tali à 4000 m. d'alt. Le 27 Juin 1887. Legit ipse J. M. Delavay." This plant is certainly of the same species as *Rh. lacteum*, Franch., Delavay No. 164.

In addition to these Paris specimens I have had for examination the collections made by Mr. Forrest in Yunnan during his several years of exploration and presented to the Royal Botanic Garden, Edinburgh, by Mr. A. K. Bulley and by Mr. J. C. Williams. Amongst these I find the following, which correspond with Delavay's Nos. 214 and 2794 and are *Rh. lacteum*, Franch.:—

Yunnan. In and on the margins of pine forests on the eastern flank of the Tali Range. Lat. 25° 40′ N. Alt.

[1] Franchet in Bull. Soc. Bot. France, xxxiv (1887), 280.

12,000 ft. Shrub of 15–25 ft. Flowers pale yellow. Forrest No. 4160. Aug. 1906.

Yunnan. Rhododendron forest. Eastern flank of the Tali Range. Lat. 25° 40′ N. Alt. 12,000 ft. Tree of 20–30 ft. Flowers pale yellow, fragrant. Forrest No. 6778. Aug. 1910.

Yunnan. Rhododendron forests. Western flank of the Tali Range. Lat. 25° 40′ N. A shrub of 15–25 ft. Alt. 12,000 ft. Flowers pure canary yellow. Forrest No. 11,575. June 1913.

And then there are the following specimens, which are certainly the same as Delavay's No. 2214 and are therefore *Rh. lacteum*, var. *macrophyllum*, Franch.:—

Yunnan. Above the pine belt on the Sung Kwei—Lang Kung divide. Lat. 26° N. Alt. 13,000–14,000 ft. Forrest No. 501. Dec. 1904.

Yunnan. Open situations in pine forests on the descent from the Sung Kwei pass to the Sung Kwei valley. Lat. 26° 15′ N. Alt. 10,000–11,000 ft. Tree of 20–30 ft. Flowers white fleshy with a blotch of rich crimson at base of corolla. Forrest No. 2159. April 1906.

Careful examination of this material shows to me that the differences separating *Rh. lacteum*, var. *macrophyllum*, Franch. from *Rh. lacteum*, Franch. are more than varietal and that we have before us here two quite distinct species.

Apart from many minor differences there are two characters by which *Rh. lacteum*, Franch. and *Rh. lacteum*, var. *macrophyllum*, Franch. can be readily distinguished one from the other. These are:

a. The indumentum of the under surface of the leaf:—

Genuine student as he was of Rhododendrons, Franchet came to recognise the importance of the indumentum as a diagnostic mark within the genus, and as bearing upon the immediate subject of discussion here I quote from one of the pregnant notes which he usually attached to his diagnoses of species after the earlier ones. Writing of *Rh. sanguineum*, Franch. he says:—"La couche crustacée qu'on observe à la face inférieure des feuilles de quelques Rhododendron n'est souvent que la strate inférieure d'un veritable tomentum; mais dans le *Rh. sanguineum* ainsi que dans le *Rh. lacteum* et quelques autres, l'indument

laineux fait réellement défaut." This states a critical difference recognisable at sight betwixt *Rh. lacteum*, Franch. and *Rh. lacteum*, var. *macrophyllum*, Franch.

The indumentum of *Rh. lacteum*, Franch. forms a uniform smooth velvety dull fawn-coloured covering to the leaf under surface and when looked at closely shows prismatic scintillate points all over. It is composed of tufts of hair-cells. Each tuft has a very short base of attachment the cells of which have a yellow-brown content. From the base spread out thin-walled unicellular branches, some four or five, of no great length. They are wide and empty, somewhat vesicular, and colourless. These tufts are close set and their branches closely interlock. The walls of these cells give the prismatic reflections on the surface of the indumentum. Many tufts form one stratum of indumentum.

In *Rh. lacteum*, var. *macrophyllum*, Franch. the indumentum of the under surface of the leaves produces a hazel-brown covering which under moderate magnification —even to the unaided eye—appears to be coarsely pitted. It is not smooth and velvety but somewhat fluffy and does not show prismatic scintillations. It is composed of cup-shaped scales each with a definite many-celled stalk expanding into a membranous cup one cell thick showing a network of the walls of the component cells. The rim of the cup is undulate and runs out at points into long tortuous threads which are intricately woven between the mouth of the cups. The tint of the cells of the cups gives the colour of the indumentum. But these cup-shaped cells at the surface of the indumentum are not the only ones. Beneath these and of all sizes down to quite few-celled almost unformed ones are other colourless scale hairs which, when as often happens the brown scales of the free indumentum surface fall off, appear as a greyish lower stratum of indumentum taking the place of the scales removed. The indumentum here is then of more than one stratum.

In the ordinary language of systematists the covering would be called a tomentum in both cases and the under surface of the leaf be described as tomentose. But in the genus *Rhododendron* there are many kinds of indumenta

that would come under the designation tomentose which differ markedly in construction and are useful diagnostic marks. I may here direct attention to a short paper by Miss E. M. Jesson[1] dealing with the indumentum of *Rh. Falconeri*, Hook. f. and *Rh. Hodgsoni*, Hook. f. in which the diagnostic value of the indumentum is clearly pointed out.

The indumentum of the ovary in *Rh. lacteum*, Franch. and *Rh. lacteum*, var. *macrophyllum*, Franch. is of the same character composed of fasciated longer or shorter hairs.

b. The colour of the flower:—

The colour of the flower in *Rh. lacteum*, Franch. is variously described by the collectors as "blanc de lait," "jaune soufre," "pale yellow," "pure canary yellow." In one of Mr. Forrest's specimens the dried flowers show quite a yellow tint. Franchet uses the word "lactée."

The flowers of *Rh. lacteum*, var. *macrophyllum*, Franch. are described by collectors as "blanches avec une légère teinte lactée," "white with a blotch of rich crimson at base." Franchet says: "corolla lactea cum maculis fuscis." In all the dried specimens the blotch is evident.

One concludes from the evidence that the flower in *Rh. lacteum*, Franch. has always a yellow tint becoming bright yellow at times and there is no crimson blotching. *Rh. lacteum*, var. *macrophyllum*, Franch. has white flowers sometimes creamy white and with a crimson blotch. It is this *Rh. lacteum*, var. *macrophyllum*, Franch. which has come into cultivation under the name *Rh. lacteum*, Franch. How did the name *lacteum* become attached to it?

In 1889[2] Hemsley cited *Rh. lacteum*, Franch. as a species of the Chinese Flora in his Enumeration, but he makes no special reference to *Rh. lacteum*, var. *macrophyllum*, Franch. published in 1887. He must have known of the variety, for his reference to Chinese localities for the species runs—"Yunnan: a tree forming woods on the Koulapo Mountains and on Yengtzehay near Lankong at 3200 metres (*Delavay*)," and "Koulapo" is the station given by

[1] Jesson in Ann. of Botany, xxix (1915), 635.
[2] Hemsley in Journ. Linn. Soc., xxvi (1889), 26.

Franchet for *Rh. lacteum*, Franch., Yeng-tze-hay the station for *Rh. lacteum*, var. *macrophyllum*, Franch. The specimens are cited from Herb. Kew. I must think that Hemsley did not devote critical examination to the plants. He is far too acute a botanist to miss the distinctions.

Subsequently in 1911 when he described in the Botanical Magazine under t. 8372 as *Rh. lacteum*, Franch. a plant—really *Rh. lacteum*, var. *macrophyllum*, Franch.—the figure of which was derived from a flowering specimen in the garden of Mr. F. D. Godman at South Lodge, Horsham—he took the same attitude. There is no reference to Franchet's variety. This as a criticism of Franchet's work was dangerous.

I have had occasion to follow along the path which Franchet trod in several fields, and the experience has always increased my admiration of his perspicacity and of the accuracy of his work. When Franchet names a varietal form within a species one may have confidence that there is a valid differential feature in the forms he deals with—different though its value be in the eyes of botanists. Franchet's attitude was conservative. Observe how he is always endeavouring to bring the Chinese novelties with which he is dealing within the limits of a specific type already known from the Himalayas. He preferred to extend the limits of a species rather than to break up an aggregate. The case before us illustrates his extension of specific limits beyond what is natural, and what I believe he himself would have allowed had he lived to publish the fuller account of the species of which these earlier descriptions were only preliminary diagnoses. For there is no doubt about it — *Rh. lacteum*, Franch. is one species, *Rh. lacteum*, Franch. var. *macrophyllum* is another.

Rh. lacteum, Franch. is apparently rare, *Rh. lacteum*, var. *macrophyllum*, Franch. more common, and the latter it is of which the seed came to Europe from Delavay and from which the plants that have flowered in cultivation have been derived. Its varietal name having been ignored it has usurped the specific one.

Diels also misunderstood the *Rh. lacteum*, Franch. In 1912, accepting an identification I had made at Paris in 1906 of Forrest's No. 501 as *Rh. lacteum*, Franch. var.

macrophyllum, Diels[1] took Forrest's No. 2159 to be the true *Rh. lacteum*, Franch. adding however, "I do not think that *macrophyllum*, Franch. is even a variety. The size of leaves seems to be a fluctuating character in these two." From his standpoint, looking on Forrest's No. 2159 as *Rh. lacteum*, Franch. and Forrest's No. 501 as *Rh. lacteum*, var. *macrophyllum*, Franch. Diels is right. These plants are the same but then neither of them is *Rh. lacteum*, Franch. They are both *Rh. lacteum*, Franch. var. *macrophyllum*.

Yet Diels had under his eye the true *Rh. lacteum* Franch. in Forrest's specimens 4160, which he placed[2] in *Rh. taliense*, Franch. It is however far removed from this species.

Franchet's two plants being distinct species it is necessary to give his var. *macrophyllum* a distinguishing name. There is already a *Rh. macrophyllum*, Don—a N.W. American species—and I have to christen the plant as I do under the name *Rh. fictolacteum*, Balf. fil.

Rh. lacteum, Franch. gives promise of being a more welcome plant in our gardens than *Rh. fictolacteum*, Balf. fil. A large-leaved Rhododendron with large trusses of canary-yellow flowers will indeed be an acquisition. Seeds of the plants in its finest form as shown in dried specimens have been procured by Mr. Forrest (No. 11,575) from which we may have it in cultivation and I hope flowering at an earlier period in its life than *Rh. fictolacteum*, Balf. fil.

The description attached to t. 8372 of the Botanical Magazine may be taken as that of *Rh. fictolacteum*, Balf. f. as it appears in cultivation, and we must await the flowering in our gardens of *Rh. lacteum*, Franch. for a full description of it for comparison with its ally. Here I content myself by crystallising in the following brief differential diagnosis what is said above:—

Rh. lacteum, Franch. Leaves not tapered to base. Under leaf indumentum unistrate smooth velvety uniform dull fawn coloured of persistent hair tufts each on a short foot. Flowers cream coloured to canary yellow.

Rh. fictolacteum, Balf. f. Leaves tapered to base.

[1] Diels in Notes R.B.G. Edin., v (1912), 215.
[2] Diels in Notes R.B.G. Edin., v (1912), 216.

Under leaf indumentum bistrate. Surface pitted not smooth hazel brown of long-stalked cup scales with fringing long hairs often deciduous and uncovering a lower series of colourless scales. Flowers white blotched crimson.

Since my note appeared in the Gardeners' Chronicle, March 25, 1916, I have been asked the question by Sir Edmund Loder, Bart.—What is *Rh. lacteum*, Franch. mentioned by Rehder and Wilson ?[1] and he has kindly sent me a leaf of this plant grown at Leonardslee under Wilson's number 4254. I have also received a leaf of the same plant from Lieut. Commander Millais who is engaged in preparing a monograph of the genus *Rhododendron*. A glance at the indumentum of the leaf suffices to tell that Wilson's No. 4254 is not *Rh. lacteum*, Franch. A more careful analysis tells that it is not *Rh. pictolacteum*, Balf. fil. I must point out however that Rehder and Wilson say of their "specimens which are in ripe fruit only" that they "appear to be identical with Franchet's plant." What the plant is may be determined when it flowers. I expect it will prove to be a new species. I have seen no specimens of Wilson's 3431.

A Hybrid Potamogeton new to the British Isles.

By Arthur Bennett, A.L.S.

(Read 13th April 1916.)

In August 1915 Messrs. Barclay and Matthews sent me some gatherings of *Potamogeton* from the river Earn, near Dunning, in mid. Perth, V.C. 88. They included *P. decipiens*, Nolte, *P. crispus*, Linn., and many specimens of $\times P.$ *venustus*, Baagve = *P. crispus* $\times$ *alpinus*, Balb. This rare hybrid has only been recorded from Denmark, and was found there by Herr Baagve in the river Gudendå, in Jyllandia, and the river Vigersdalå, in Saellandia, in 1879.

The Scottish specimens are of the two nearer *crispus*, while the Danish ones are about half-way between the two species. At this date no *alpinus* was gathered, but *alpinus* is on record for the Earn from near Dupplin and Forteviot.

[1] Rehder and Wilson, Plantae Wilsonianae, i (1913), 545.

the latter place being three miles further down the river than Dunning. But Mr. Barclay wrote me: "I have little doubt it will be found at or above the place of the hybrid, and I hope to search for it there."

× *P. venustus* was published by Baagve in Compt. rend. (Congrès de botanique), Paris, p. 517, 1900.

P. crispus × *alpinus*, Baagve, in litt. et sp.

P. alpinus × *crispus*, Asch. et Graeb, in Engler, Pflanzenr., iv, 11 (1907), pp. 132 and 162; and on page 72 they refer to it under *P. alpinus*, var. *undulatus*, Fischer (but the margins are not undulated or serrated); and Asch. et Graeb. in Syn. Flora Mitt. Europas, ed. 2 (1913), p. 515.

The two German authors make a point of reversing the names in hybrids, though the sequence given by the authors of the hybrids was no doubt intentional.

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

VOLUME XXVII.

PART II.

SESSION 1916–17.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY BY
NEILL & CO., LIMITED.

And to be obtained from the SECRETARY OF THE SOCIETY, *at the Royal Botanic Garden.*

1917.

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TRANSACTIONS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXI.

On the Affinities of Sedum Praegerianum, W. W. Sm., with a Tentative Classification of the Section Rhodiola. By R. Lloyd Praeger, B.A. (Plates II–IV.)

(Read 8th February 1917.)

Sedum Praegerianum, W. W. Sm. (Plate II, figs. 1-3), collected in the Chumbi Valley, Tibet, in 1912, and in cultivation at Edinburgh (and, by the kindness of Professor I. Bayley Balfour, in my own garden), presents several features which, singly or in combination, are unusual in the genus to which it belongs. The erect root-stock is very short, and does not lengthen appeciably with age; it produces, below, thick fleshy roots recalling those of the Rhodiola section, and, above, a flat rosette of stalked lanceolate entire leaves, which fade in autumn. From the axils of these leaves the flowering-shoots develop in summer; these latter are prostrate, slender, and leafy, and terminate in a loose cyme of rosy flowers which are egg-shaped (fig. 2), the petals being very erect and almost touching at the tips.

As stated above, the root-stock, in spite of its abbreviated form, recalls that of the Rhodiola section, in which it is always thickened and usually elongate. The rosette of leaves which crowns the short root-stock is very unusual, and in the genus is found chiefly in certain annual or biennial species, such as the European *S. Cepaea*, Linn., the Caucasian Sempervivoides group, and some of the

Chinese annuals, with none of which *S. Praegerianum* has any affinity. But a closer parallel among species which, being in cultivation, are fully available for comparison, is found in *S. primuloides*, Franchet, one of Delavay's Yunnan plants, now well known in gardens (Plate III, fig. 4). In *S. primuloides* similar rosettes of entire stalked leaves (in this case ovate, fig. 6) are found, but in *S. primuloides* the root-stock is slenderer, much-branched, and aerial, forming a tiny bush, each branch with a terminal leaf-rosette. Next, the axillary flower-stems of *S. Praegerianum* are most unusual in the genus, but are again exactly matched in *S. primuloides*, which agrees further in its ovoid flowers (fig. 5); this last feature, also very unusual in Sedum, is on the other hand approached in a few of the Rhodiolas—for instance, in *S. ruriflorum*, N. E. Br., a recently described Chinese species (fig. 7). So that the affinities of *S. Praegerianum* appear to lie with the Rhodiola section on the one hand, and more directly with *S. primuloides* on the other.

An examination of *S. Praegerianum* reveals another feature unusual in Sedum. The petiole widens at the base to three or four times its normal diameter (fig. 3), and is attached to the root-stock by the whole breadth of this expansion, so that the cicatrix produced by removing a leaf is a horizontal line running round a considerable arc of the periphery of the root-stock. To find an analogue to this, we turn again to *S. primuloides*, where a precisely similar form of leaf-base is found (fig. 6). It seems clear, then, that there is a close affinity between *S. Praegerianum* and *S. primuloides*; but where are these two aberrant species to be placed in a classification of the genus?

The points of resemblance between *S. Praegerianum* and the Rhodiola section of Sedum have been pointed out already. Rhodiola, as established as a genus by Linnaeus (Genera Plantarum, ed. i, p. 318, 1737), envisaged only those plants, now usually placed under Sedum, which have dioecious, tetramerous flowers. Scopoli (Introd. ad Hist. Nat., 255, 1777) employed the term in the same sense, as a section of Sedum. As knowledge of these plants increased, it became clear that in a hard-and-fast sense this definition could not stand, as closely allied plants

were found, some of them not even specifically distinct (in the ordinary sense) from true Rhodiolas, and all having the characteristic Rhodiola facies, which were pentamerous, and polygamous or hermaphrodite. The Linnaean definition, in fact, did not separate out a natural group. A better definition was clearly to be based on the growth-form—the thick caudex crowned with scales from the axils of which arise simple leafy annual flower-stems, whether these flowers are dioecious and tetramerous (these two characters generally, but not always, going together), as in *S. roseum*, Scop. (*S. Rhodiola*, DC.), *S. elongatum*, Wall., and *S. himalense*, D. Don, or hermaphrodite and pentamerous, as in *S. crassipes*, Wall. (*S. asiaticum*, auct., nec DC.), *S. linearifolium*, Royle, and *S. trifidum*, Wall. It seems better to follow Ledebour and Maximowicz in using the term Rhodiola in this wider meaning, than Boissier and Hooker (in Journ. Linn. Soc., Bot., ii, 95) who use it in its restricted sense. The growth-form referred to separates all the Rhodiolas from other Sedums. It is most nearly approached in the section Telephium and in some species of the series Aizoonta of the section Seda Genuina (*e.g.*, *S. Aizoon*, Linn. and *S. Selskyanum*, Regel); in these the caudex is thickened, and similarly gives rise to annual leafy flowering shoots; but the characteristic scale-leaves are absent, and the shoots arise either from the axils of the lowest leaves of the previous season's shoots, or from indefinite points on the caudex near the base of the former shoots.

In this wider sense, then, the section Rhodiola is characterised by its much thickened and usually elongate caudex, crowned with scales, from the axils of which arise unbranched leafy flowering shoots. In some of the more familiar members of the section, such as *S. roseum*, Scop. and its allies (*heterodontum*, H. f. et T., *Kirilowi*, Regel, etc.), these scales are not very well developed; they are short, broad, and dry and membranous from an early stage. But in certain other species, belonging both to restricted Rhodiola and to that group in its wider sense, the scales are much better developed, and a study of them throws light on the question of the affinities of *S. Praegerianum*. When these Rhodiolas are mature, with

elongate aerial rhizomes which are lengthening slowly, the scales are short and crowded round the growing point; but in plants in vigorous growth, or in seedlings, they have a greater importance, and assume instructive forms. Under certain circumstances, too, such as exuberant growth, or when the rhizome is cut off below the surface of the ground, slender subterranean sucker-like branches of the root-stock are produced, whose behaviour after reaching the surface deserves attention.

Fig. 8 represents one season's growth of a vigorous aerial shoot of the root-stock of *S. justigiatum*, H. f. et T., a typical Himalayan dioecious, tetramerous-flowered Rhodiola: for clearness, the leafy flower-shoots have been cut away. The form of the scales is seen clearly here, and it is to be noted that the younger ones are prolonged into a blunt linear tip, which is green and leaf-like. A further stage in the development of the scales is seen in fig. 9, which represents the upper part of a sucker-like shoot arising from a root-stock cut off below ground of *S. himalense*, D. Don, another dioecious, tetramerous-flowered Rhodiola from the same region. Here the scales are quite leaf-like, and form a small rosette, their broad clasping bases being prolonged upwards into green oblong laminae (fig. 10), which in texture and colour resemble the leaves of the flower-shoots. The subterranean lower scales are distant, colourless, and thin, with axillary buds which give rise to branches of the sucker: the axils of the upper aerial leaf-like scales in the following season produce flower-shoots.

Let us next take *S. crassipes*, one of the Rhodiolas with hermaphrodite 5-parted flowers and an elongate root-stock, widely spread in the Himalayan region. Fig. 11 shows a sucker similar to that last referred to, but rather older. Here the scales have the usual clasping base, and a well-developed lanceolate slightly toothed lamina (fig. 12); they are, in every sense, leaves. From their axils flower-shoots are seen rising. Below ground the scale-leaves are small; and at the apex of the shoot they have already passed beyond the leafy stage, and have adopted the crowded habit and reduced size found in the mature plant, the lamina having shrunk to a mere flat green tip.

The seedling forms of *S. crassipes* show an analogous

development.[1] Following on the two seed-leaves (seen in fig. 13) a rosette of scale-leaves similar to those just described is produced. Fig. 13 shows a seedling three months old. The next drawing (fig. 14) illustrates a plant a month older, with the first flower-shoot arising from the axil of one of the lower scale-leaves. The close similarity of these scale-leaves of *S. crassipes* to the leaves of *S. Praegerianum* does not need emphasising.

Here, then, we find the explanation of the peculiar characters of *S. Praegerianum* and *S. primuloides*—their rosettes of leaves, their clasping leaf-base and axillary flower-shoots, and their flowers akin to those of some of the hermaphrodite Rhodiolas. It seems clear that they are primitive Rhodiolas in which are still preserved the leaves which clothed the root-stock of ancestral forms; these leaves, in the majority of living species, being represented merely by membranous scales. Thus viewed, as members of the Rhodiola section, *S. Praegerianum* and *S. primuloides*, apart from their peculiar leaf-rosette, fall easily within the limits of that group as hitherto understood, which embraces a considerable variety of plant forms. The root-stocks of both, though approaching those of typical Rhodiola, are unusual—the former by reason of its extreme shortness, and the latter on account of its slenderness and repeated branching. For the characters of the flower-stems, stem-leaves, inflorescence and flowers, analogues can easily be found among the Asiatic Rhodiolas.

It may be added here that among the Mexican Sedums, which show a very wide range of growth-forms, the *primuloides* type sometimes occurs—in *S. Palmeri*, S. Wats. and *S. compressum*, Rose, for instance, where leaf-rosettes borne at the ends of the branches give rise to axillary leafy flower-shoots bearing terminal cymes; in *S. nutans*, Rose (*Cremnophila nutans*, Rose), where similar axillary leafy shoots bearing large elongated panicles are produced from ample loose rosettes; and in *S. pachyphyllum*, Rose, in which the leafy axillary flower-shoot arises from a stem which is more elongate than those of the species just mentioned, and which is clothed with leaves for the greater

[1] Some account of the seedling stage of this species and of *S. roseum* will be found in Lubbock, Seedlings, i, 514–516.

part of its length. But none of these American species have the broad clasping leaf-base or the thickened root-stock of the Rhodiola section, and they have reached their present form along some other line of descent.

So far I have dealt only with species which I have had an opportunity of studying in the growing state, because these can be watched at different stages of growth, and under varying conditions. Dried material is not nearly so satisfactory among plants which vary so much and dry so badly as the group with which we are dealing. Descriptions are still less satisfactory: for instance, the clasping leaf-base, which I believe I am right in treating as of first importance, is not mentioned in the original descriptions of *S. primuloides* and *S. Praegerianum*. Nevertheless, further points regarding the questions dealt with above may be gleaned from a study of dried specimens, where available, and of the descriptions of some other species—mostly recently published—from the area extending from Afghanistan to China. Some further evidence derived from living plants is also added. Beginning at the *Praegerianum* end of the series, three species have been described by M. Raymond Hamet—*S. Hobsonii*,[1] *S. Durisi*,[2] and *S. Balfouri*[3] (the first and third from Tibet, the second from Central Asia)—which are clearly allied to *S. Praegerianum*. The descriptions are full, and I have examined the types of the first and third. In all the caudex is short, thick and erect as in *Praegerianum*, and is similarly crowned with a rosette of entire leaves, attached to the caudex by a broad clasping base. In *S. Balfouri* these leaves are sessile, linear-obovate, mucronate at the apex, very broad at the base (fig. 15). They closely resemble those specially vigorous scale-leaves of *S. himalense* (fig. 10) to which reference was made on a previous page. The axillary flower-stems of *S. Balfouri* are quite tall (over a foot), and its inflorescence and flowers recall those of *Praegerianum*. In *S. Durisi* the lamina is "obovato-suborbicularis," very obtuse, cuspidate; the indistinct petiole "latissimum, cuneiforme, basi latum." *S. Hobsonii* comes quite near *S. Praegerianum*; the leaves are

[1] Kew Bulletin, 155, 1913. Type at Kew.
[2] Bull. Soc. Bot. France, lx, 446, 1913.
[3] Notes Roy. Bot. Gard. Edin., viii, 116, 1912. Type at Edinburgh.

very similar, but smaller, ovate-oblong with a long, broadly linear petiole equalling the lamina, widening below to a very broad, deltoid-semiorbicular base; the axillary flowering-stems, flowers, and general appearance much resemble those of *S. Praegerianum*.

Next, several species have affinities with *S. primuloides*—viz. *S. pachyclados*,[1] *S. Leveilleanum*,[2] and *S. leucocarpum*.[3] The habitats of these lie far apart—Afghanistan, Quelpaert, and Yunnan respectively. *S. pachyclados* (of which there are specimens at Kew) reproduces closely the growth-form of *S. primuloides*, the caudex being aerial and much-branched. The leaves (fig. 16), which are borne in terminal rosettes, are small, obovate, bluntly toothed, and the very short petiole expands into the characteristic clasping base (though not referred to in the description). The flowers are smaller, more open, and more numerous than in *S. primuloides*. Of the remaining two species the descriptions are not sufficiently full for our purpose; but *S. Leveilleanum* has a thick erect caudex with dense rosettes of sessile entire cuspidate cuneiform-linear leaves $\frac{1}{4}$ inch in length, and short leafy (? axillary) flower-stems. As regards *S. leucocarpum*, the details given do not allow of a complete reconstruction of the plant, but apparently it belongs here also.

Two other species, *S. Karpelesae*, R. Hamet[4] from Tibet and *S. Levii*, R. Hamet[5] from Sikkim, appear to connect the *Praegerianum-primuloides* series with the *crassipes* type (in which the scales, at first often green and often terminated by a short narrow lamina, become later membranous and triangular or semicircular). These two species have thick (? elongate) caudices and axillary flower-stems. The inner younger scale-leaves are green and are expanded into an ovate entire stalked lamina (figs. 17, 18); when the lamina fades, the expanded base remains as a membranous scale of *crassipes* type. This shape of caudex-leaf is well matched by those of young plants of *S. Farreri*, W. W. Sm.[6]

[1] Aitchison and Hemsley, Journ. Linn. Soc. (Bot.), xviii, 58, 1880.
[2] R. Hamet in Bull. Soc. Bot. France, lv, 712, 1909.
[3] Franchet in Journ. de Bot., x, 288, 1896.
[4] Bull. Soc. Bot. France, lviii, 615, 1911.
[5] Ibid., lvi, 568, 1909.
[6] Notes Roy. Bot. Gard. Edin., ix, 125, 1916.

(fig. 19): in this species, by the end of the first year, these juvenile leaves have given place to green deltoid acute scales, like those of *S. crassipes*, *S. himalense*, etc.; a similar case is shown in fig. 20, which represents the juvenile caudex-leaf of a Chinese species (Ward, No. 764) not yet described: here also triangular scales soon replace the petiolate leaves of the young plant.

Compare also the long-stalked orbicular seedling-leaves of *S. bupleuroides* (fig. 21). This species is one of the small-scaled *roseum* series; the seedling, after producing about three of these leaves[1] during the first few months of its life, abruptly exchanges them for quite insignificant brown scales (figs. 22, 23).

Leaving now those species which in the mature state possess caudex leaves with a petiole and distinct lamina, there follows a large group, showing considerable diversity of habit, leaf, and flower, but agreeing in its thick, mostly elongate caudex, well-developed scales often prolonged while young into a short, narrow, green lamina, and flowers (as in the preceding groups), hermaphrodite and 5-parted. The old scales are membranous, the old flower-stems often persistent, the carpels usually slender and erect, with slender erect styles. The familiar *S. crassipes*, Wall. (*S. asiaticum*, Clarke nec DC.) may be taken as a type. Some twenty species, which range from the Himalayas to China, may be placed here. The well-known and peculiar Himalayan *S. trifidum*, Wall. seems to fit best with this group, although in its scales it comes nearer the *roseum* group referred to below.

We arrive now at Rhodiola *sensu stricto*—a group differing from the last in its usually 4-parted dioecious flowers, with short carpels crowned with short styles which are reflexed in fruit. The plants which belong here divide themselves into two tolerably well-marked groups:—*S. himalense*, D. Don and allied species on the one hand, with well-developed scales resembling those of the *crassipes* group, and old stems usually persistent: and, on the other hand, the familiar *S. roseum*, Scop. and its allies, with poorly-developed scales and deciduous flower-stems.

[1] It may be noted that the expanded base of the seedling-leaves of *S. bupleuroides* is suffused with purple, precisely as in *S. primuloides*.

The considerations put forward in the preceding pages point to the definition and classification of the section Rhodiola which is given below. The great variability of many of the species (see Hooker and Thomson in Journ. Linn. Soc. (Bot.), ii, 93–95) makes precise classification difficult. Furthermore, in the case of some of the species of which specimens are not available to me, the descriptions are not sufficiently full to allow of their being placed with certainty. I have marked with an asterisk the species which I have had an opportunity of studying in the living state; the placing of some of the remainder must be regarded as tentative. I have put a ? before one or two species of the position of which I am doubtful.

Certain species, as is to be expected in so puzzling an assortment of forms as the Rhodiolas, are difficult to place, because they are intermediate between two groups, or boldly combine certain characters of two. Thus, *S. trifidum* has the small scales and deciduous stems of the *Roseae*, and the 5-parted hermaphrodite flowers and slender carpels of the *Crassipedes*. *S. discolor* bears short carpels and short styles spreading in fruit of *Roseae* type in hermaphrodite flowers like those of the *Crassipedes*. *S. Smithi*, in its linear scales ending in a long subterete tail, links the *Crassipedes* with *S. Karpelesae* and *S. Levii*, belonging to the Primuloides series.

Genus *SEDUM*.

Section RHODIOLA.

Caudex fleshy, crowned with leaves with a broad clasping base (often reduced to membranous deltoid or semi-orbicular scales, or becoming so with age), from the axils of which leafy flowering shoots are produced.

Series 1. RHODIOLAE *sensu stricto*.

Flowers usually unisexual and 4-parted, caudex usually elongate or greatly thickened. Carpels usually short and crowned with short styles reflexed in fruit.

Group 1. ROSEAE.—Caudex-leaves scale-like, short, membranous, not green even when young. Old flower-stems not persistent.

**bupleuroides*, Wall.
crenulatum, H. f. et T.
Crassa, R. Hamet.
**elongatum*, Wall.
gelidum, Ledeb.
**heterodontum*, H. f. et T.
**Kirilowi*, Regel.
**longicaule*, Praeger.
**purpureo-viride*, Praeger.
**roseum*, Scop.[1]
rotundatum, Hemsl.
Stapfii, R. Hamet.
suboppositum, Maxim.

Group 2. Himalenses.—Caudex-leaves scale-like, usually green and fleshy when young, often prolonged into a short narrow lamina or cauda. Old flower-stems usually persistent.

algidum, Ledeb.
Bouvieri, R. Hamet.
coriaceum, Wall.
**fastigiatum*, H. f. et T.
**himalense*, D. Don.
humile, H. f. et T.
quadrifidum, Pallas.
**tibeticum*, H. f. et T.

Series 2. Crassipedes.

Flowers hermaphrodite and 5-parted. Caudex elongate or greatly thickened. Caudex-leaves scale-like, usually green and fleshy when young, often prolonged into a short narrow lamina or cauda. Old flower-stems persistent or deciduous. Carpels usually slender and crowned with slender styles not reflexed in fruit.

**crassipes*, Wall.
discolor, Franch.
dumulosum, Franch.
euphorbioides, Schlecht.
**Farreri*, W. W. Sm.
Liciae, R. Hamet.
linearifolium, Royle.
macrolepis, Franch.
nobile, Franch.
Praini, R. Hamet.
**rariflorum*, N. E. Br.
Rendlei, R. Hamet.
**rhodanthum*, A. Gray.
scabridum, Franch.
**Semenovii*, Masters.
Smithi, R. Hamet.
**Stephani*, Cham.
Tieghemi, R. Hamet.
**trifidum*, Wall.

Series 3. Primuloides.

Flowers hermaphrodite and 5-parted. Caudex slender elongate, or short not much thickened (comparatively). Caudex-leaves leaf-like, with a distinct lamina, usually petiolate.

Group 1. Longicaules.—Root-stock elongate, much branched.

leucocarpum, Franch.
Leveilleanum, R. Hamet.
pachyclados, Aitch. et Hemsl.
**primuloides*, Franch.

[1] Including the several North American "species" of Rhodiola, which appear to be no better entitled to specific rank than many of the Eurasian forms of this polymorphic species.

Group 2. BREVICAULES.—Root-stock very short, branched slightly or not at all.

Balfouri, R. Hamet.
Durisi, R. Hamet.
Hobsonii, R. Hamet.
Karpelesae, R. Hamet.
Levii, R. Hamet.
?*Mossii*, R. Hamet.[1]
**Praegerianum*, W. W. Sm.

According to the views brought forward above, the oldest type of Rhodiola now living is represented by *S. Praegerianum*, with short caudex and large caudex-leaves. Thence a complicated series of forms shows a progressive increase in length and thickness of caudex and decrease in size of the caudex-leaves; *S. primuloides*, *S. Levii*, *S. Smithi*, for instance, being progressive steps to the *crassipes* type, where the caudex-leaves, now reduced to mere scales at the summit of aerial succulent root-stocks, still show when young a green, leaf-like colour and a tendency to an incipient (or rather relict) lamina. At this point in the series the flowers, hitherto perfect and pentamerous, begin to show a tendency to dioecism and tetramerism, which becomes more pronounced as caudex development increases and scale development weakens, till in *S. roseum* and its allies we have a group of species with massive caudices crowned with small chaffy scales, from the axils of which rise strong stems bearing corymbs of dioecious tetramerous flowers. It is important to note that seedlings throughout the whole series, from *Praegerianum* to *roseum* (so far as I have had an opportunity of studying them), show what is here taken to be the primitive type of caudex-leaf—a leaf having a lanceolate to orbicular lamina, and a petiole with a broad clasping base. The different types of leaves found still persisting among the primitive *Primuloides* series can be matched, often with a remarkable closeness, in the seedling stage of members of the Crassipedes, Himalenses, and Roseae, the mature plants of which bear only scales.

As regards the question of the geographical distribution of the plants dealt with above, the Rhodiolas are essentially an Asiatic group. One species only (the N. American *S. rhodanthum*, A. Gray) does not occur in Asia; and only one other (*S. roseum*, Scop.), which is also the most variable

[1] Caudex missing in the type specimens. Appears to be allied to *S. Balfouri*.

of the whole section, spreads beyond the confines of Asia, ranging from Japan to Ireland, Greenland, and across N. America. The groups of species into which Rhodiola has been divided above show more or less well-marked centres of distribution, sometimes contradicted (as is so often the case when one is dealing with distributional problems) by some notable exception.

Series RHODIOLAE *sensu stricto*.—Of some twenty species, rather more than half are Himalayan plants, and almost all of these are confined to that region: but one of them (*S. roseum*) is the most widespread of all the Rhodiolas. Four have a wide range over Central and Eastern Asia, two are confined to Tibet, and two to Western China.

Series CRASSIPEDES.—Of nineteen species, eight are Chinese (mainly Yunnan), five Himalayan, four come from Siberia, Turkestan or Tibet; and one (*S. rhodanthum*) from Western N. America.

Series PRIMULOIDES.—The Longicaules group have their homes far apart—one in Afghanistan, two in Yunnan, and one in Quelpaert: while of the Brevicaules, four come from Tibet, one from the Himalayas, one from Central Asia, and one from China.

Roughly speaking, half the Roseae are confined to the Himalayan region, half the Crassipedes to China, and half the Primuloides to Tibet: if we take those three regions as constituting a single area, we find that to that area are confined about three-fourths of the Roseae and Crassipedes, and practically the whole of the Primuloides: in other words, nearly four-fifths of the whole section Rhodiola.

DESCRIPTION OF PLATES.

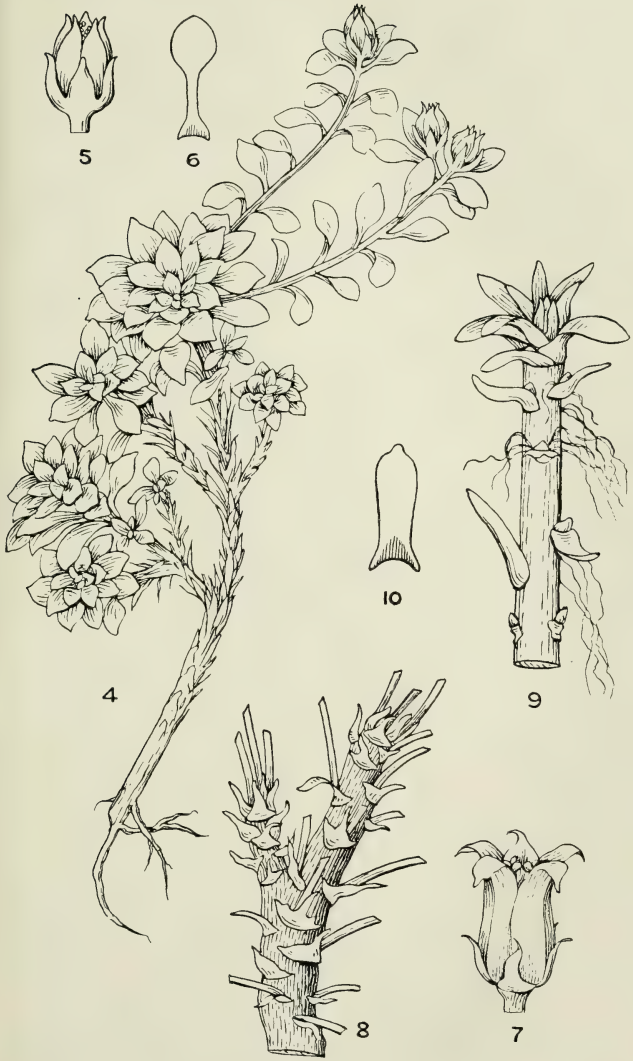
PLATE II.

FIG. 1. *Sedum Praegerianum*, $\frac{1}{1}$.
„ 2. „ „ flower and bud. $\frac{2}{1}$.
„ 3. „ „ leaf. $\frac{1}{1}$.

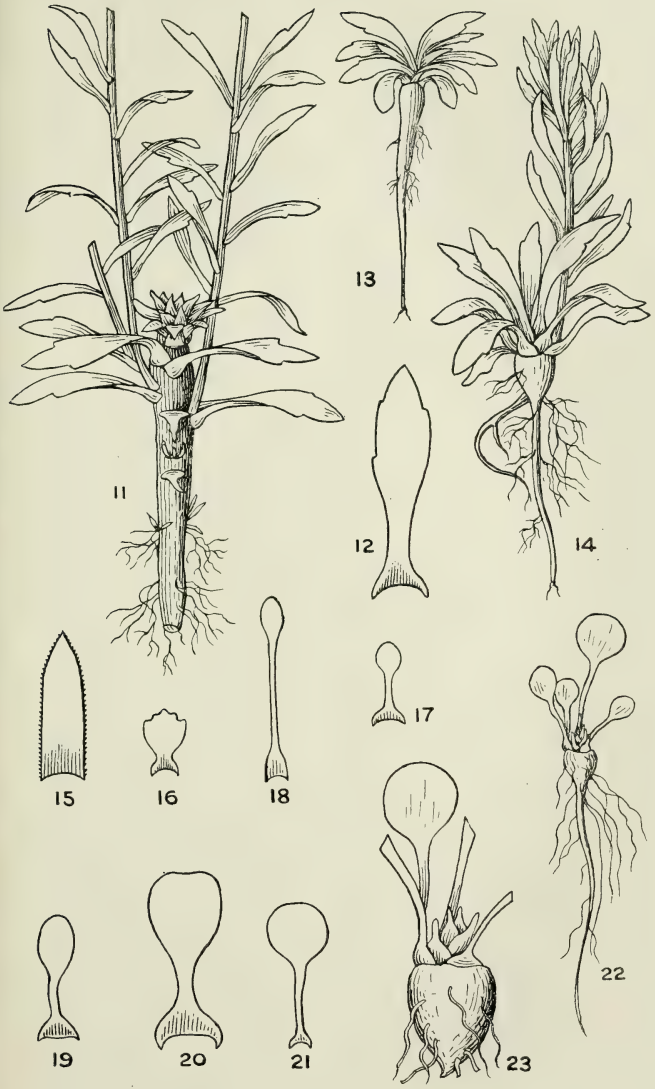
PLATE III.

FIG. 4. *Sedum primuloides*, $\frac{1}{1}$.
„ 5. „ „ flower. $\frac{2}{1}$.
„ 6. „ „ leaf. $\frac{1}{1}$.
„ 7. *Sedum rariflorum*, flower. $\frac{2}{1}$.
„ 8. *Sedum fastigiatum*, vigorous caudex branch. $\frac{1}{1}$.
„ 9. *Sedum himalense*, sucker. $\frac{1\frac{1}{2}}{1}$.
„ 10. „ „ „, leaf of same. $\frac{1\frac{1}{2}}{1}$.

R. Lloyd Praeger.



R. Lloyd Praeger.



R. Lloyd Praeger.

PLATE IV.

FIG. 11. *Sedum crassipes*, sucker. $\frac{11}{1}$.
„ 12 „ „ „ , caudex-leaf of same. $\frac{2}{1}$.
„ 13. „ „ seedling, three months. $\frac{11}{1}$.
„ 14. „ „ „ , four months. $\frac{1\frac{1}{2}}{1}$.
„ 15. *Sedum Balfouri*, leaf of rosette, after drawing by R. Hamet in Herb. Edinburgh. $\frac{1}{1}$.
„ 16. *Sedum pachyclados*, leaf of rosette. $\frac{1}{1}$.
„ 17. *Sedum Karpelesae*, leaf of rosette, after R. Hamet's description. $\frac{2}{1}$.
„ 18. *Sedum Levii*, leaf of rosette, after R. Hamet's description. $\frac{2}{1}$.
„ 19. *Sedum Farreri*, caudex-leaf of seedling. $\frac{1}{1}$.
„ 20. *Sedum* sp. (Ward, 764) caudex-leaf of young plant. $\frac{1}{1}$.
„ 21. *Sedum bupleuroides*, caudex-leaf of seedling. $\frac{1}{1}$.
„ 22. „ „ seedling, four months. $\frac{1}{1}$.
„ 23 „ „ „ , growing point of same specimen. $\frac{3}{1}$.

CAVEA: A NEW GENUS OF THE COMPOSITAE FROM THE EAST HIMALAYA. By W. W. SMITH, M.A., and JAMES SMALL, M.Sc. (Plate V.)

(Read 12th October 1916.)

Cavea, W. W. Sm. et J. Small. Genus nov. *Compositarum*.

Genus *Inuloidearum*; in schemate Benthamiano apud *Plucheineas* ponendum; prope *Plucheam* interim melius allocatum a qua habitu, inflorescentia, receptaculo abunde differt; ab *Inuloideis* aliis aliquatenus remotum; certe habitu *Saussuream* vel *Berardiam* simulat sed characteres florales haud conveniunt.

Herba perennis. Caules solitarii vel bini subscaposi plus minusve foliosi capitulum unicum gerentes. Folia alterna dentata vel denticulata. Capitula magna heterogama subglobosa floribus exterioribus ♀ multiseriatis fertilibus, floribus disci ☿ circ. 20–30 sterilibus. Involucri phylla multiseriata imbricata lanceolata vel lineari-oblonga exteriora herbacea interiora plus minusve scariosa. Receptaculum convexum fimbrillatum. Corollae pallido-purpureae vel sordide albidae. Corollae ♀ filiformes, stylo suo longiores, apice 3–4-denticulatae; corollae ☿ regulares tubulosae alte 5-lobae. Antherae basi breviter atque

obtusiusculc appendiculatae appendicibus contiguis plus minusve connatis. Styli florum ♀ filiformes bifidi ad margines papillosi: styli florum ♀ indivisi extus papillosi. Achaenia parva compressiuscula obscure quadrangula dense villosa. Pappi nitide purpurei setae plurimae uniseriatae scabridae nec plumosae; in floribus sterilibus pappus exiguus achaeniis abortivis glabris.

Genus monotypicum montium himalaicorum prope fines tibeticos incola.

Carex tanguensis, W. W. Sm. et J. Small. Comb. nov.

Saussurea tanguensis, J. R. Drummond in Kew Bull. (1910), 78; Smith and Cave in Rec. Bot. Surv. Ind., iv (1911), 212.

India:—Sikkim, near the Tibetan frontier; hill behind Tangu bungalow, 4920 m., Younghusband, without number in Herb. Kew and Herb. Calc.; Thé La, 4600 m., Smith and Cave, No. 2161 in Herb. Kew and Herb. Calc.; Jongsong La valley, 5080 m., Smith and Cave, No. 2357 in Herb. Kew and Herb. Calc.

This interesting plant was discovered in the north-west corner of Sikkim near the Tibet frontier at an altitude of over 15,000 feet, and very near the limit of vegetation for the area. Its habitat is generally loose, shingly screes. One of the dominant genera of the area is *Saussurea*, and *Carex* has much in common as regards habit with several of the Himalayan species of that genus. Its position in or near the *Pluchineae* is, in our present knowledge, where we find we must put it on the characters presented, but the authors realise that such a position may not be its natural one. It has been with hesitation that this extreme alpine has been associated with *Pluchea*, *Blumea*, and *Laggera*. If the characters permitted, its placing near *Saussurea* or *Berardia* would have been more satisfactory from the *facies* of the plant. The generic name attached to the plant is in honour of Mr. George Cave, Curator of the Lloyd Botanic Garden at Darjeeling, an indefatigable traveller and collector over the whole of Sikkim, and one to whom the discovery of many new plants is due.

The plant was first described by Mr. J. R. Drummond from material collected by Sir F. Younghusband while

engaged on the Tibet Frontier Commission. The flowers of the first collections were unfortunately damaged by weevils and did not afford sufficient data for critical examination. It was consequently taken to be a singular species of *Saussurea*, with *S. Thomsoni*, Clarke and *S. bracteata*, Decaisne as its nearest allies. More satisfactory material now available gives the following characters, which do not accord well with *Saussurea* :—

(1) The absence of the typical ring of hairs below the stigmatic region; (2) the absence of long basal appendages to the anthers; (3) the presence of filiform female florets; (4) the character of the pappus, which is scabrid or barbellato-scabrid, not plumose; (5) the villous achene; (6) the absence of paleae from the receptacle.

The plant is a perennial, with a slightly woody base and a rosette of lanceolate, sparsely dentate leaves. The stem is leafy, with about six small, ovato-lanceolate or ovate leaves (fig. 1). Usually the plant has only one stem, but two occur sometimes. The capitulum, which is shown in fig. 1, is compressed but is naturally subglobose. The involucral bracts are multi-seriate, lanceolate, acuminate and ciliate near the tips (fig. 8). The outer bracts are herbaceous and the inner bracts are rigid and more or less scarious. The receptacle is convex and fimbrillate (fig. 8). There are several rows of filiform florets towards the outside, and 20 to 30 male disc florets (fig. 1). These disc florets may be altogether absent. The filiform florets are female and fertile (figs. 6 and 9). The style is branched and shorter than the corolla; the style branches are flattened with rounded tips; the stigmatic papillae are marginal, extending to the apex of the branches (fig. 7). The stamens are absent. The corolla is slender, tubular, hairy on the outside near the middle, and the apex is marked by three or four small teeth (fig. 6). The pappus (fig. 9) is setose, copious, uniseriate, scabrid (fig. 10), 8–9 mm. long, and purple in colour. The mature achene is 5 mm. long, densely villous (fig. 9), and the upper hairs seem to have been mistaken by Drummond with his incomplete material for an outer series of setae. The disc florets are sterile; the aborted achene is glabrous, and the pappus consists of a few (about ten) setae. The style is undivided and papillose

on the outside (fig. 3). The stamens have the typical apical appendage and short, obtuse, basal appendages, the contiguous appendages being more or less connate (figs. 4 and 5). The corolla is tubular, regularly and deeply 5-lobed; the style is not exerted (fig. 2).

The structure of the style and stamens and the presence of filiform female florets at once suggests the *Inuleae*. According to Bentham's classification of the order the new genus falls into the sub-tribe *Pluchеinеae* of the *Inuleae*, and from the floral characters should be placed near *Pluchea*, from which it is distinguished by habit, receptacle, and inflorescence. A few species of *Pluchea* are herbaceous perennials, but most are shrubby. The capitulum in *Pluchea* is usually small and the inflorescence corymbose, but at least one species (*P. aromatica*, Balf. f. from Socotra) shows large capitula and a diffusely corymbose inflorescence. The receptacle is *naked* and the anther tails are *connate and acuminate* in *Pluchea*. The new genus is distinguished from *Blumea* and *Laggera* by the undivided style of the male florets, fimbrillate receptacle, general habit, and quite a few other characters; and no other genus in the *Inuleae* approaches it closely.

The large percentage of capitula with no male florets is interesting as showing a tendency to dioecism, but the most interesting point is the placing of the plant in *Saussurea* by Drummond. In Table I of a paper[1] by one of us the *Inuleae* are shown to be more closely allied in their anther appendages to the *Mutisieae* and *Cynareae* than to the tribes among which they are usually placed. The typical style of the *Inuleae* closely approaches some of the *Mutisieae* and exceptional *Cynareae*. From the study of all factors, including geographical distribution, it seems probable that the *Inuleae* gave rise to the *Cynareae* in the eastern part of the Mediterranean region, through the *Buphthalmeae*, so that it is not surprising that, in the absence of an investigation of the filiform florets, this plant should have been classed in the *Cynareae*. The absence of the ring of hairs on the style and the character of the anther appendages, however, would, even then, place it nearer the

[1] Small, J., The Pollen-presentation Mechanism in the Compositae. Annals of Botany, vol. xxix, No. cxv (1915), p. 457.

Cavea tanguensis, W. W. Sm. et J. Small.

Gochnatieae in the *Mutisieae* (near *Berardia* in Hoffmann's classification) than in *Saussurea*.

The fimbrillate receptacle and the barbellato-scabrid setae of the pappus are interesting in view of further unpublished work by one of us, which shows that the paleae on the receptacle, *especially in the Cynareae*, may be a development of the foveolate and fimbrillate types of receptacle, while the plumose pappus is obviously derived from the simple setae by the elongation of the "barbs." Altogether the genus *Cavea* makes quite a probable, although somewhat remote, ancestor of *Saussurea* and its allies.

EXPLANATION OF PLATE V.

Fig. 1. *Cavea tanguensis*, Smith et Small, complete plant. Nat. size.
Fig. 2. Male floret, showing corolla and anther tube. ×6 circa.
Fig. 3. Upper part of style of male floret. ×15 circa.
Fig. 4. Anther tube. ×12 circa.
Fig. 5. Anther, showing apical and basal appendages. ×20 circa.
Fig. 6. Female floret, showing corolla only. ×6 circa.
Fig. 7. Upper part of style of female floret. ×15 circa.
Fig. 8. Capitulum, showing involucre and receptacle. Nat. size.
Fig. 9. Complete female floret, showing ripe achene. Nat. size.
Fig. 10. Upper part of seta of pappus. ×8 circa.

Mosses of West Lothian (V.C. 84). By J. C. Adam.

(Read 8th February 1917.)

In this paper an attempt has been made to compile a complete list of the mosses of West Lothian based upon published records, information and specimens given to me, and my own collections and observations. Very little has been published, so far as I can ascertain, regarding the moss flora of this county. Four species are recorded by Greville in his Flora Edinensis (1824), and a few others are given under the parishes of Abercorn, Ecclesmachan, and Bo'ness in the New Statistical Account of Scotland, vol. ii (1845). These have all been quoted here, but the synonomy of some of the latter is obscure, and the present existence in the county of the rarer species requires verification. In a paper by W. Bell and J. Sadler, Trans. Bot. Soc. Edinburgh, vol. x (1869), p. 251, there is a list of

mosses collected in an excursion between Manuel and Linlithgow; but as precise localities are not given, and as the excursion evidently covered ground both in Stirlingshire and Linlithgowshire, this list has not been quoted here. Some of Messrs. Bell and Sadler's specimens are, however, in the Herbarium, Royal Botanic Garden, Edinburgh, and will be found quoted as from that source. The Census Catalogue of British Mosses (1907) enumerates 166 species and varieties as occurring in V.C. 84. The sources of these records appear to have been the aforementioned works, Edinburgh Herbarium, and unpublished lists by Mr. W. Evans and Mr. J. M'Andrew. Mr. Evans and Mr. M'Andrew have kindly placed a great deal of their data at my disposal, and the definite localities for their contributions to the Census Cat. have been given here whenever known. No definite locality or reliable authority has been found for some of the Census Cat. records; these have been included here and ascribed to the Census Cat. In a paper in Scot. Bot. Rev., vol. i (1912), p. 202, Mr. M'Andrew contributed 24 additions to the Census Cat. list for V.C. 84. These have been quoted here with, in some cases, amended descriptions of localities as supplied to me by Mr. M'Andrew.

The following list enumerates 216 species and varieties as compared with 190 recorded in the Census Cat. and Mr. M'Andrew's published list of additions. Doubtless additions will still be made: the Sphagna, for example, have been very imperfectly worked, and several fairly common mosses are still unknown from this county.

My own investigations in the county were pursued until the outbreak of war, in conjunction with Mr. S. E. Brock. The latter's absence on military service has prevented more recent co-operation, but a considerable amount of the material used here was gathered in our joint field-work. I am indebted to the Regius Keeper for enabling me to examine certain specimens in the Herbarium, Royal Botanic Garden, Edinburgh; to Mr. Evans and Mr. M'Andrew for much kind help and information; to Mr. R. H. Meldrum and Mr. D. A. Jones for verifying many of my specimens; and to Mr. J. A. Wheldon for naming or confirming several *Sphagna* and *Hypna* (*Harpidia*).

Authorities for records are abbreviated as follows:— W. E. = W. Evans. J. M'A. = J. M'Andrew. S. E. B. = S. E. Brock. Records for which no authority is quoted are based upon material gathered by myself. Records not included in the Census Cat. or M'Andrew's list of additions are marked by an asterisk.

Sphagnum cymbifolium, Ehrh. Drumshoreland Moss, J. M'A. in Scot. Bot. Rev., i, p. 204. Fauldhouse Moss, W. E.

*var. **glaucescens**, W., f. **squarrosulum**, Pers. Houston Wood.

S. compactum, De Cand. Drumshoreland Moss, J. M'A., l.c., p. 204 (sub *S. rigido*).

var. **squarrosum**, Russ. Drumshoreland Moor, W. E.

***S. cuspidatum**, Ehrh. Blawhorn Moss, W. E.

var. **submersum**, Schp., f. **rigescens**, W. Balvormie Wood.

***S. recurvum**, P. Beauv., var **majus**, Angstr., f. **sylvaticum**, Russ. Houston Wood.

S. molluscum, Bruch. Drumshoreland Moss, J. M'A., l.c., p. 204 (sub *S. tenello*).

S. fimbriatum, Wils. Drumshoreland Moss, J. M'A., l.c., p. 204.

S. Girgensohnii, Russ. Drumshoreland Moss, J. M'A., l.c., p. 205.

S. acutifolium, Ehrh. Blawhorn Moss; Houston Wood.

***S. crassicladum**, W., var. **diversifolium**, W. Pond in Houston Wood.

***S. rufescens**, Limpr., var. **albescens**, W. Houston Wood.

Andreaea petrophila, Ehrh. Cocklerue, W. E.

Tetraphis pellucida, Hedw. Census Cat.

***T. Browniana**, Grev. Parish of Bo'ness, New Stat. Acc., ii, p. 125.

Catharinea undulata, Web. & Mohr. Common in damp woods, especially along the river ravines.

Polytrichum nanum, Neck. Craigie Wood, J. M'A.

P. aloides, Hedw. Drumshoreland, W.E.; abundant on the banks of Breich Water; Drumtassie Burn.

P. urnigerum, L. Bank of River Avon below Canal aqueduct.

P. piliferum, Schreb. Common on walls and dry stony places, specially in the upland parts of the county.

P. juniperinum, Willd. Common on waste places, and dry peaty places on the moors.

P. gracile, Dicks. Hopetoun woods; Houston Wood; Fauldhouse Moor.

P. commune, L. Very common in woods and on moors throughout the county.

Pleuridium axillare, Lindb. Ditch near Linlithgow, W. E. Drumshoreland Curling Pond, J. M'A.

P. subulatum, Rabenh. Footpath on west side of Craigiehall Wood; N.B. railway embankment near Craigie, J. M'A., l.c., p. 205.

P. alternifolium, Rabenh. N.B. railway embankment near Craigie, J. M'A., l.c., p. 205.

***Ditrichum homomallum**, Hampe. Bank of River Avon below Canal aqueduct. [*Didymodon heteromallum* recorded from parish of Bo'ness in New Stat. Acc., ii, p. 127, probably refers to this species.]

[*Didymodon capillaceum*. Parish of Abercorn, New Stat. Acc., ii, p. 22.] If this is *D. capillaceum*, Schrad. = *Swartzia montana*, Lindb., it is unlikely to have occurred in this district.

***Seligeria recurvata**, B. & S. Near Ecclesmachan.

Ceratodon purpureus, Brid. Very common.

Rhabdoweisia denticulata, B. & S. Summit of Cocklerue, J. M'A.

Cynodontium Bruntoni, B. & S. Binny Crag, W. E. Cocklerue, J. M'A., l.c., p. 205, seems to be an error, and probably refers to Mr. Evans' record.

Dichodontium pellucidum, Schp. Breich Water; River Almond; River Avon.

Dicranella heteromalla, Schp. Common on shady banks, in woods, etc.

D. cerviculata, Schp. Drumshoreland Moor, J. M'A.; near Winchburgh, W. E.; near Fauldhouse; Humbie Quarry, Kirkliston.

D. varia, Schp. Drumshoreland, W. E. Almondell.

D. squarrosa, Schp. Near Cocklerue, W. E.

Dicranoweisia cirrata, Lindb. Binny Crag, Grev. Flora Edin., p. 237 (sub *Weissia*). Common on trunks of trees, rocks, etc., in all parts of the county.

Campylopus flexuosus, Brid. Blawhorn Moss.

C. pyriformis, Brid. Balvormie; Houston Wood; and other peaty woods and moors. [*Dicranum flexuosum* described as covering entire bank at Tod's Mill, in abundant fructification, parish of Bo'ness, New Stat. Acc., ii, p. 125, may refer to this species.]

C. fragilis, B. & S. Avon valley, W. E.

Dicranum Bonjeani, De Not. Stream near Binny Crag, W. E.; Calabraes, Bathgate Hills.

D. scoparium, Hedw. Woods, moors, rocky places, and sometimes tree trunks throughout the county.

D. majus, Turn. Bowdenhill.

Leucobryum glaucum, Schp. Blawhorn, W. E.; Bee Crags · Houston Wood.

***Fissidens exilis**, Hedw. Clay bank, Winchburgh, W. Edgar Evans.

F. pusillus, Wils. Linlithgow, W. Bell. (Herb. Edin.); Dalmeny Park, W. E.; Midhope Glen, S. E. B.

F. incurvus, Starke. Near Port Edgar, J. M'A., l.c., p. 205.

F. bryoides, Hedw. Frequent on damp shady banks, Avon and Almond ravines, Midhope Glen, etc.

F. adiantoides, Hedw. Old quarry, Galabraes, Bathgate.

F. taxifolius, Hedw. Bridge Castle, W. E. Midhope Glen.

Grimmia apocarpa, Hedw. Common on walls in the upland region. Frequent elsewhere.

var. **rivularis**, W. & M. River Avon; Ecclesmachan Burn.

G. maritima, Turn. Shore east of South Queensferry, W. E.; shore near Society.

G. pulvinata, Smith. Common on walls both in the upland and lowland parts of the county.

G. trichophylla, Grev. Parish of Bo'ness, New Stat. Acc., ii, p. 127; Craigiehall Wood, J. M'A.; near Carlowrie, W. E.; Craigs Quarry, Kirkliston.

***G. leucophaea**, Grev. Parish of Abercorn, New Stat. Acc., ii, p. 22.

Rhacomitrium aciculare, Brid. Common on rocks in most of the streams.

R. fasciculare, Brid. Common on rocks and walls.

R. heterostichum, Brid. Western heights of Ecclesmachan parish, New Stat. Acc., ii, p. 110 (sub *Trichostomo*). Common on rocks and walls, especially in the upland region.

R. lanuginosum, Brid. Bowdenhill.

R. canescens, Brid. Western heights of Ecclesmachan parish, New Stat. Acc., ii, p. 110 (sub *Trichostomo*). Near North Mains.

var. **ericoides**, B. & S. Census Cat.

Ptychomitrium polyphyllum, Fürn. Wall near Craigton; stones by roadside south of Linlithgow; old quarry, Philpstoun.

Hedwigia ciliata, Ehrh. Craigiehall Wood, J. M'A.

Phascum cuspidatum, Schreb. Census Cat.

***P. cuspidatum**, Schreb., var. **piliferum**, Hook. & Tayl. South Queensferry, W. E.

Pottia Heimii, Fürnr. Parish of Bo'ness, New Stat. Acc., ii, p. 127 (sub *Gymnostomo*). East side of Forth Bridge, W. Edgar Evans. Mouth of Longreen Burn, Dalmeny shore, J. M'A.

P. truncatula, Lindb. Field near South Queensferry, W. E. Near Kirkliston.

***P. minutula**, Fürnr. Drumshoreland, W. E.

P. lanceolata, C. M. Wall near Kirkliston, Grev. Flora Edin., p. 236 (sub *Weissia*). Old bing, Craigton.

***Tortula rigida**, Schrad. Grows abundantly by riverside at Inneravon, New Stat. Acc., ii, p. 124.

T. ambigua, Angstr. Bank of River Almond near Illieston.

T. muralis, Hedw. Very common on walls throughout the county.

T. subulata, Hedw. Ecclesmachan, Craigton, and elsewhere frequent.

***T. intermedia**, Berk. Wall by towpath of Union Canal near Auldcathie; old bing, Craigton.

T. ruraliformis, Dixon. Hopetoun shore, S. E. B. Shore at Dalmeny Park, W. E.

Barbula lurida, Lindb. Railway cutting, Port Edgar, J. M'A., l.c., p. 205.

B. rubella, Mitt. Common on damp walls, stony places, etc.

B. tophacea, Mitt. Parish of Bo'ness, New Stat. Acc., ii, p. 127 (sub *Didymodon trifario*). Rocks by the Almond below Cramond Brig, W. E. Bank of River Almond near Illieston; railway cutting, Winchburgh; railway cutting, Port Edgar.

B. fallax, Hedw. Bank of River Almond near Illieston.

B. spadicea, Mitt. Stones in River Almond near Cramond, W. E.

B. rigidula, Mitt. Drumshoreland, W. E.

B. cylindrica, Schp. Wall at Carlowrie; W. E.; wall by towpath of Union Canal, Auldcathie; boundary wall of Newliston Park.

B. vinealis, Brid. Wall near Livingstone.

B. Hornschuchiana, Schultz. West of South Queensferry, J. M'A., l.c., p. 205.

B. revoluta, Brid. Old stone walls about Kinneil, New Stat. Acc., ii, p. 125 (sub *Tortula*). Common on mortar of dry walls.

B. convoluta, Hedw. Old road near Bellside, and elsewhere frequent.

B. unguiculata, Hedw. Common on walls, waste ground, etc.

Leptodontium flexifolium, Hampe. Binny Crag; about Craigiehall Dykes, J. M'A.; Dechmont Law.

Weisia viridula, Hedw. Earthy rocks, River Almond, at Illieston; and elsewhere frequent.

*var. **densifolia**, B. & S. Carribber Glen, W. E.

***W. mucronata**, B. & S. Drumshoreland, W. E.

W. rupestris, C. M. Mouth of railway tunnel, Port Edgar, J. M'A.

W curvirostris, C. M. Ecclesmachan, Grev. Fl. Edin., p. 227 (sub *Gymnostomo*). Very abundant and luxuriant in the railway cutting near Winchburgh.

W. verticillata, Brid. Census Cat

Trichostomum flavovirens, Bruch. About Society and elsewhere on shore near South Queensferry, J. M'A. and W. E.

Cinclidotus fontinaloides, P. Beauv. River Almond at Craigiehall, J. M'A.; Ecclesmachan burn; River Avon.

Encalypta vulgaris, Hedw. Blackness, W. E.

E. streptocarpa, Hedw. Abundant on walls near Torphichen and Linlithgow.

Zygodon Mougeotii, B. & S. Rocks in Carribber Glen.

Z. viridissimus, R. Brown. Near Linlithgow, W. Bell (Herb., Edin.).
var. **rupestris**, Hartm. Wall west of South Queensferry.

Z. Stirtoni, Schp. Near South Queensferry, W. E.

***Ulota Bruchii**, Hornsch. Carribber Glen, W. E.

U. phyllantha, Brid. Shore at South Queensferry.

***Orthotrichum anomalum**, Hedw., var. **saxatile**, Milde. Wall by towpath of Union Canal near Craigton; stones in old quarry, Philpstoun; loose rocks, Bathgate Hills.

***O. cupulatum**, Hoffm., var. **nudum**, Braithw. River Almond at Craigiehall, J. M'A. Rocks in River Avon below Canal aqueduct.

O. affine, Schrad. Dalmeny Park, W. E.

O. rivulare, Turn. Linlithgow, W. Bell, anno 1869 (Herb., Edin.) Still in this locality on the River Avon in June 1916.

O. pulchellum, Smith. South Queensferry; Drumshoreland Moor, Grev. Fl. Edin., p. 249.

O. diaphanum, Schrad. Parish of Bo'ness, New Stat. Acc., ii, p. 125.

***Splachnum sphaericum**, Linn. fil. Blawhorn Moss, W. E., 1916.

Ephemerum serratum, Hampe. Field at Drumshoreland, W. E.

Physcomitrella patens, B. & S. West of South Queensferry, J. M'A., l.c., p. 205.

Physcomitrium pyriforme, Brid. Near Linlithgow, J. M'A.

Funaria Templetoni, Sm. A barren specimen growing on a rock in the River Avon was doubtfully referred to this species by R. H. Meldrum.

F. hygrometrica, Sibth. Very common throughout the county.

Aulacomnium palustre, Schwaeg. Drumshoreland and Fauldhouse, W. E. Blawhorn Moss; Houston Wood.

***A. androgynum**, Schwaeg. On sunk wall and fallen timber, Newliston; wall near Kirkliston Distillery.

Bartramia ithyphylla, Brid. Kirkliston Distillery, J. M'A., l.c., p. 205.

B. pomiformis, Hedw. Crevices of rocks, banks, and walls both in the upland and lowland regions; frequent.
var. **crispa**, B. & S. Carribber Glen, W. E.

Philonotis fontana, Brid. Common along the streams and ditches of the upland country.

P. calcarea, Schp. Beside Canal, near Linlithgow, J. M'A.

***Breutelia arcuata**, Schp. Drumshoreland Moor, W. E.

Leptobryum pyriforme, Wils. Kirkliston Distillery, J. M'A., l.c., p. 205.

Webera cruda, Schwaeg. Wall near Cramond Bridge, J. M'A. Rocks by stream, S.W. of Binny Crag, W. E. Rocks, Carribber Glen; rocks by roadside south of Linlithgow.

W. nutans, Hedw. Abundant on banks, earthy rocks and walls, and decaying timber in the lowlands; and on the moors in the uplands.

W. annotina, Schwaeg. Drumshoreland, J. M'A., l.c., p. 205. Fields near Balvormie.

W. proligera, Bryhn. Binny Crag, W. E.

***W. carnea**, Schp. Bank of River Almond, near Livingstone, W. E. Bank of River Almond, Illieston; bank of River Avon below Canal aqueduct.

W. albicans, Schp. Railway cutting, Winchburgh; banks of the Avon and the Almond; and elsewhere by damp roadsides, etc., frequent.

Bryum pendulum, Schp. Wall, Hawes Brae, J. M'A.

B. pallens, Sw. Bank of River Avon.

B. pseudo-triquetrum, Schwaeg. Railway cutting, Winchburgh.

B. bimum, Schreb. Drumshoreland, W. E.

B. caespiticium, L. Common on mortared walls.

B. capillare, L. Very common on damp walls.

B. atropurpureum, W. & M. Walls near South Queensferry, Greville, (Herb. Edin.).

B. alpinum, Huds. Cocklerue, J. M'A., l.c., p. 205.

B. argenteum, L. Common on waste ground, footpaths, etc.

B. roseum, Schreb. East of Longreen, Dalmeny, J. M'A. Near Blackness Castle, W. Edgar Evans.

Mnium affine, Bland. Near Torphichen and Carlowrie, W. E. Carribber Glen.

M. cuspidatum, Hedw. Humbie Quarry, near Winchburgh, W. E.

M. rostratum, Schrad. Parish of Bo'ness, New Stat. Acc., ii, p. 127 (sub *Bryo*). Ditch, Swineburn, Kirkliston, S. E. B. Carlowrie, W. E. Carribber Glen, W. Edgar Evans.

M. undulatum, L. Parishes of Abercorn and Bo'ness, New Stat. Acc., ii, p. 22 and p. 127 (sub *Bryo ligulato*). Common in damp woods, especially in the river ravines.

M. hornum, L. Very common in woods and shady places.

M. serratum, Schrad. Bank of River Almond above Cramond Bridge, J. M'A. Carribber Glen, W. E.

M. stellare, Reich. North of Linlithgow; Carribber Glen (the locality on which the Census Cat. record was based, W. E.).

M. punctatum, L. Parish of Abercorn, New Stat. Acc., ii, p. 22 (sub *Bryo*). Common on damp banks and rocks by streams, also in marshes and bogs in the moorland region.

M. subglobosum, B. & S. Census Cat.

Fontinalis antipyretica, L. River Avon; Ecclesmachan Burn; pond near Port Edgar.

Neckera complanata, Hübn. Parish of Bo'ness, New Stat. Acc., ii, p. 127 (sub *Hypno*). Avon valley near Woodcockdale.

Homalia trichomanoides, B. & S. Below Cramond Bridge, J. M'A. Avon valley near Woodcockdale; Almond valley near Illieston.

Pterygophyllum lucens, Brid. Parish of Bo'ness, New Stat. Acc., ii, p. 127 (sub *Hookeria*). Carribber Glen, W. E.

Porotrichum alopecurum, Mitt. Parish of Bo'ness, New Stat. Acc., ii, p. 127 (sub *Hypno*). Inchgarvie, South Queensferry, S. E. B. Carribber Glen; River Almond near Illieston.

Leskea polycarpa, Ehrh. River Almond below Cramond Bridge, J. M'A.

Heterocladium heteropterum, B. & S. Census Cat.

Thuidium tamariscinum, B. & S. Common in open deciduous woods, etc.

T. recognitum, Lindb. West of South Queensferry, J. M'A., l.c., p. 205.

Climacium dendroides, Web. & Mohr. Old bing, Craigton; and frequent in marshy places in the uplands.

Camptothecium sericeum, Kindb. Common on walls both in the upland and lowland districts.

C. lutescens, B. & S. Census Cat.

Brachythecium albicans, B. & S. Hopetoun shore, S. E. B. Dalmeny shore, J. M'A. Binny Crag, W. E.

B. rutabulum, B. & S. Common on damp ground, shady walls, etc.

B. rivulare, B. & S. Rocks by River Avon and River Almond.

B. velutinum, B. & S. Craigiehall Wood, J. M'A. Damp wall near Philpstoun and similar situations frequent.

B. populeum, B. & S. Carribber Glen, W. E. Almond valley near Illieston.

B. plumosum, B. & S. Carribber Glen.

B. purum, Dixon. Common on damp grassy banks and fields.

Eurhynchium piliferum, B. & S. Hopetoun woods, New Stat. Acc., ii, p. 125 (sub *Hypno*). Almondell; Carribber Glen; Kirkliston Distillery.

E. crassinervium, B. & S. Almond valley below Cramond Bridge and below Craigiehall Bridge, J. M'A.

E. praelongum, Hobk. Very common in the lowland woods, etc.

E. Swartzii, Hobk. Near Philpstoun.

E. myosuroides, Schp. Carribber Glen; Almondell; Canal embankment, Winchburgh.

E. myurum, Dixon. Almondell; near Linlithgow.

E. striatum, B. & S. Almondell; Avon valley.

E. rusciforme, Milde. Common in most of the streams which do not suffer from excessive pollution.

E. murale, Milde. Old stone walls about Kinneil, New Stat. Acc., ii, p. 125 (sub *Hypno*). On Dalmeny shore, west of River Almond, J. M'A. Old wall in wood by River Avon, Woodcockdale.

E. confertum, Milde. Damp wall by Union Canal, Philpstoun, and similar situations frequent.

Plagiothecium depressum, Dixon. Side of River Almond below Craigiehall Bridge, J. M'A.

P. elegans, Sull. Craigiehall Wood; Almond valley south of Cramond Bridge, J. M'A. Bridge Castle, W. E.

P. denticulatum, B. & S. Cocklerue, J. M'A. Common on banks and rocks in shady places.

P. sylvaticum, B. & S. Craigiehall Wood, J. M'A.; near Binny Crag, W. E.

P. undulatum, B. & S. Common in woods, on heaths, etc., throughout the county.

Amblystegium serpens, B. & S. Common on damp walls, stones, and old tree stumps.

A. filicinum, De Not. Near Linlithgow, W. Bell (Herb., Edin.). West of South Queensferry, J. M'A. Railway cutting, Winchburgh ; frequent in the river ravines.

Hypnum riparium, L. Linlithgow Loch, J. M'A., l.c., p. 205. West of South Queensferry, J. M'A. Humbie Reservoir, W. E.

H. stellatum, Schreb. Census Cat.

var. **protensum**, Röhl. Drumshoreland Curling Pond, J. M'A., l.c., p. 205. Wall south of Linlithgow ; old limestone workings north of Bathgate.

H. aduncum, Hedw. non L. Census Cat. (may be based on record by Bell and Sadler in Trans. Bot. Soc. Edin., 1869 ; see *H. falcatum*).

H. fluitans, L. Fauldhouse Moor, W. E.

*var. **falcatum**, Schp. Houston Wood.

H. exannulatum, Gümb. Drumshoreland Curling Pond, J. M'A., l.c., p. 205.

*var. **pinnatum**, Boul., f. **acuta**, Sno. Houston Wood. f. **montana**, Ren. Drumshoreland, J. M'A. (Herb., Wheldon). f. **gracilis**, Ren. Drumshoreland Curling Pond, J. M'A. (Herb., Wheldon).

H. uncinatum, Hedw. Common on moist banks and rocks, especially in the Almond and Avon ravines.

H. commutatum, Hedw. Railway cutting, Winchburgh.

***H. falcatum**, Brid. Linlithgow, W. Bell (Herb. Edin.)—named *H. aduncum* in Bell's handwriting, and evidently the plant upon which record by Bell and Sadler in Trans. Bot. Soc. Edin. was based.

H. cupressiforme, L. Very common on walls, fallen timber, etc.

var. **resupinatum**, Schp. Dalmeny Park, W. E.

var. **filiforme**, Brid. Trees in the Avon ravine.

var. **ericetorum**, B. & S. Blawhorn Moss, W. E. Houston Wood ; Drumshoreland Moor.

H. Patientiae, Lindb. South of Linlithgow, J. M'A. Near Bathgate, W. E. Roadside near North Mains.

H. molluscum, Hedw. Almondell ; Carribber Glen ; Bathgate Hills.

H. palustre, Huds. River Almond at Cramond, J. M'A. Rocks by the River Avon, and by most of the rocky streams in the county.

***H. eugyrium**, Schp., var. **Mackayi**, Schp. Riccarton, W. E.

H. ochraceum, Turn. Census Cat.

***H. stramineum**, Dicks. Blawhorn, W. E. Fauldhouse ; Houston Wood.

H. cordifolium, Hedw. Drumshoreland Curling Pond, J. M'A., l.c., p. 205. Pond near Philpstoun House.

H. cuspidatum, L. Very common in marshes and wet places by ponds and streams.

H. Schreberi, Willd. Common in heathy woods like Drumshoreland and Houston, and on the upland pastures.

Hylocomium splendens, B. & S. Bank of River Avon near Canal aqueduct; frequent in the uplands.

H. loreum, B. & S. Cocklerue and Drumshoreland, W. E. Bowdenhill.

H. squarrosum, B. & S. Common in woods, grassy banks, damp pastures.

H. triquetrum, B. & S. Dalmeny Park and Drumshoreland, W. E., Bellside woods.

CERATOPHYLLUM DEMERSUM, LINN. IN THE ORKNEY ISLES. BY ARTHUR BENNETT, A.L.S.

(Read 8th February 1917.)

Mr. Magnus Spence (author of the Flora Orcadensis) has sent me living specimens of the above from Graemshall Loch, in the south of the Mainland. I know of no certain record north of Forfar, where it is plentiful in the Lochs of Rescobie and Balgavies.

But there is no climatal or distributional reason against its occurrence to the extreme north of Scotland, as it occurs in Sweden to W. Norrland in 65° N. lat., in Norway at Ullenensaker in 60° 5′ N. lat., and in Finland in 63° N. lat.

Mr. Spence's specimens are also of interest, as they are provided with winter-buds, or gemmae. I have looked through many British and European Floras but can find no mention of such. So I sent specimens to Mr. W. Worsdell, F.L.S., and he kindly replied: "Many thanks for sending me the winter-buds of *Ceratophyllum*. They seem to be known, however. I have to-day found a reference to them in Schenk's Biologie des Wassergewächse as follows: 'Irmisch found in many cases that the leaves of the branch-tips became curved over one another and the older internodes died off, so that the terminal buds represented small, loosely-compacted, isolated clumps, which grow out in spring.'"

These winter-buds seem to be very like those of *Utri-*

cularia, having the same dense texture, with stiff hairs in abundance.

Mr. R. Heddle reported *Ceratophyllum* from "Loch of Ayre, Kirbister." But Col. H. H. Johnston has a specimen from Heddle, and it proves to be *Utricularia vulgaris*, Linn., which Miss Boswell reported for Orkney in Watson's Top. Botany, i, p. 319 (1874).

Ulex nanus, Forster in Caithness.

By Arthur Bennett, A.L.S.

(Read 8th February 1917.)

Lately (14th October 1916) Mr. G. Lillie of Lybster sent me specimens of *Ulex nanus* from Ben Alisky, a hill in the parish of Halkirk, about 12 miles north of Berriedale. The hill is 1142 feet high, and the *U. nanus* occurred at about 800 feet. The specimens are very dwarf, the young stems very hairy with white shaggy hairs. Beneath the primary spines are here and there unifoliate leaves, exactly the same as I possess in seedlings of *U. europaeus*; these are above the trifoliate leaves (which succeed the cotyledonary ones), and number nine before the spines commence.

There are no roads near this hill; "the nearest house is Dallawillan Lodge, about a mile from it."

Mr. G. Lillie writes that his niece and nephew (Miss A. Lillie and Mr. W. Lillie of Watten Manse) found the plant on an excursion to Morven, and "although the general effect of the hill is rather barren, it had, among other plants, *Vaccinium Vitis-Idaea, Arctostaphylos Uva-ursi, Listera cordata, Lycopodium alpinum*, and *Solidago Virga-aurea*."

This locality is the most northern in Europe, being about 58° 20′ N. lat. I know of no station in Europe north of 50° N. lat.

The only Scottish stations I have seen specimens from are Kirkcudbright (Professor Oliver) and Dumfries (Mr. Fingland).

Note on Insect Visitors to Corallorhiza innata and some other Orchids in the Forth District.

By William Evans, F.R.S.E.

(Read 12th April 1917.)

In Knuth's Handbook of Flower Pollination (Engl. ed. iii, p. 347, 1909) no "visitor" is given in the case of *Corallorhiza innata*, R. Br.; but, from the small size of the flowers, it is concluded "that they are visited by small insects, which use the anterior downwardly bent part of the labellum as an alighting-platform, and creep thence to the nectar secreted and concealed at the steeply downwardly bent base of the organ." As proof of the correctness of the first part of this conclusion, the following incident seems worth putting on record.

On June 5, 1908, I found a group of half a dozen spikes of the coral-root orchid (*Corallorhiza innata*) in a stretch of rather boggy ground beside Loch Leven, Kinross-shire. The flowers were at their best, and had proved attractive to a species of small black fly, numbers of which were settled on each of the spikes. When disturbed they were in no haste to leave the flowers (perhaps the nectar had made them drowsy), creeping away among the grass rather than attempting to escape by flight, so that their capture was an easy matter. A score might have been secured without any difficulty; but, as it was, two for identification were all that I took. An attempt, with Mr. P. H. Grimshaw's help, to identify them at the Royal Scottish Museum having failed, I submitted the specimens to Mr. Austen, of the British Museum, who found them to agree with an *Empis* from Nairn which he had labelled ? sp. nov. Here the matter rested till last year, when Mr. J. E. Collin saw my two specimens and identified them as a species standing in the late Mr. Verrall's collection under the MS. name of *Empis snowdoniana*. Though no description of it has, so far as I am aware, yet been published, the species, with Verrall's MS. name for it, has been recorded from Sutherland by Colonel Yerbury in the Scottish Naturalist for December 1912.

My Loch Leven specimens are both males, as were also, I believe, all the others at the coral-root flowers, on the nectar of which they were doubtless feeding. Unfortunately I did not think of observing how they reached the hidden nectar, but one might conjecture that the long proboscis—a characteristic of the genus *Empis*—would be useful in this connection. Empids, of both sexes, besides sucking nectar, prey also on small insects, chiefly Diptera. In the use of this insect prey, a very remarkable habit in relation to courtship has been investigated by Mr. A. H. Hamm (see report by Professor Poulton, in Ent. Mo. Mag., 1913, p. 177). In some species the male, as they play in the air, presents the female with a fly which she carries about and sucks during pairing. In others the gift takes the form of a coccoon which he has spun about the fly. Or the plaything may consist of some such object as the stamen of a buttercup.

Empis snowdoniana is a small, blackish, somewhat shining fly, with pale smoky-brown wings. Length (head and body) about 5 mm.; expanse of wings about 9 mm. It is probably not uncommon in early summer on meadows and moors in the Edinburgh district. Besides the Loch Leven examples, I have a female taken above Silverburn, on the south side of the Pentland Hills, May 27, 1895, and a male from Bavelaw Moss, to the north of the same range, May 20, 1904.

In the case of *Goodyera repens*, R. Br., Knuth states that only humble bees (e.g. *Bombus pratorum*, L., in North Scotland, and *B. mastrucatus*, Gerst., in the Alps) had so far been observed as visitors to its flowers; but that Müller "is inclined to think, however, that the true pollinators are small, short-tongued insects, to which the structure of the flower is adapted." On August 7, 1909, happening to pass through a pine wood in East Lothian where this interesting orchid grows, I noted the following insect-visitors to the flowers:—viz. *Bombus pratorum*, L., a good many; *B. lucorum*, L., many; and two hover-flies, *Syrphus cinctus*, Zett., and *Platychirus albimanus*, F., one of each. The visitors thus comprise Diptera as well as bees.

Adjoining the same pine wood, some plants of *Listera ovata*, R. Br., were in fine flower, and furnished the following

fairly long list of visitors:—Hymenoptera: small ichneumon-fly, two. Diptera: *Rhamphomyia nigripennis*, F. (a small Empid), one; *Syrphus cinctellus*, Zett., one; *S. vitripennis*, Mg., two: *Hydrotaea irritans*, Fln., two; *Pteropaetria frondescentiae*, L., two. Coleoptera: *Meligethes aeneus*, F., one: *Malthodes minimus*, L., one; *Anaspis rufilabris*, Gyll., a great many. Hemiptera: *Pithanus maerkeli*, H.-S., one; *Lygus leucorum*, Mey., one. Pseudo-Neuroptera: *Mesopsocus unipunctatus*, Müll. On one of the spikes were three young snails, apparently *Helix arbustorum*.

None of the above appears among the visitors to *L. ovata* mentioned by Knuth.

On a flowering spike of *Orchis maculata*, L., growing along with the *L. ovata*, the small brownish beetle, *Anaspis rufilabris*, so abundant on the latter plant, was also present in considerable numbers.

Some Moss Records for Selkirk, Peebles, and the Lothians. By William Evans, F.R.S.E.

(Read 8th February 1917.)

The discovery of mislaid specimens and notes, and the results of some further field-work, since the publication of the Census Catalogue of British Mosses in 1907, have enabled me to supply records filling up many of the gaps in respect of the above counties. A number of these records were included by Mr. James M'Andrew in his Notes on Some Mosses from the Three Lothians (Scot. Bot. Rev., 1912, p. 202), while all the Linlithgowshire (West Lothian) ones have been given to Mr J. C. Adam for inclusion in his paper on the Mosses of that county (*antea*, p. 123). The additions contained in the present paper, therefore, relate to a large extent to the Selkirk and Peebles lists, the former of which must still be far from complete—in the Catalogue it is credited with barely sixty species. In December 1901, the late James Murray, author of the list of Mosses in the Handbook of the Fauna and Flora of "Clyde," sent me a list of 104 species he had collected in

the Broughton district of Peeblesshire. All, with three exceptions as mentioned below, are, however, given for the county in the Census Catalogue.

From the point of view of the local bryologist the Census Catalogue leaves much to be desired; it supplies him simply with a list of the species the compilers had records of from any particular county, no localities or other data being given, though to some extent these may, no doubt, be traced in the literature cited. To a great extent, however, the Catalogue is based on unpublished information. In these circumstances I have thought it desirable to include in this paper the more interesting of the records supplied by myself to the compilers.

It only remains to add that practically all my records have been at one time or another authenticated by the submission of specimens either to Mr. H. N. Dixon or Mr. R. H. Meldrum.

The nomenclature is uniform with that of the Census Catalogue.

Co. 79, Selkirk.

The additions to the list for this county, which was largely supplied by me, are as under:—The date of the Selkirk and Bowhill records is August 1903, and that of the Galashiels ones November 1910.

Polytrichum piliferum Schreb. Turf-capped walls, Selkirk.

P. juniperinum Willd. Stream-side south of Yarrow.

P. gracile Dicks. Near Galashiels.

P. commune L. Tushielaw (Ettrick), and south of Yarrow.

Ceratodon purpureus Brid. South of Yarrow; Galashiels.

Dicranella heteromalla Schp. Selkirk; Yarrow; Galashiels.

D. squarrosa Schp. East of Newhall Water between Yarrow and Traquair, May 1917.

Dicranum majus Turn. Banks of Yarrow at Bowhill.

Leucobryum glaucum Schp. Near Tushielaw, Aug. 1903.

Fissidens bryoides Hedw. East of Newhall Water.

Grimmia apocarpa Hedw., var. **rivularis**, W. & M. Newhall Water.

G. pulvinata Smith. Selkirk; Galashiels, etc.

Rhacomitrium fasciculare Brid. Wall near Galashiels.

R. heterostichum Brid. Selkirk; Galashiels, etc.

R. lanuginosum Brid. Hills near Tushielaw, and south of Yarrow.

R. canescens Brid. Selkirk; east side of Newhall Water.

Hedwigia ciliata Ehrh. Near Galashiels.

Pottia truncatula Lindb. Field at Selkirk.

Tortula muralis Hedw. Walls about Selkirk and Galashiels.

T. subulata Hedw. Selkirk; Bowhill.

T. ruralis Ehrh. On wall east of Newhall Water, May 1917.

Barbula rubella Mitt. Selkirk; Bowhill; Galashiels.

B. cylindrica Schp. Bowhill.

B. unguiculata Hedw. Selkirk; Galashiels.

Ulota Bruchii Hornsch. On birches east of Newhall Water.

Orthotrichum Lyellii H. & T. On trees at Selkirk and Bowhill.

O. affine Schrad. Near Galashiels; on wall east of Newhall Water.

O. diaphanum Schrad. Wall near Galashiels.

Aulacomnium palustre Schwaeg. East of Newhall Water.

Bartramia ithyphylla Brid. Banks of Yarrow at Bowhill.

B. pomiformis Hedw. Near Galashiels.

Webera nutans Hedw. Galashiels; south of Yarrow.

W. albicans Schp. Selkirk; east of Newhall Water, May 1917.

Bryum pallens Sw. East of Newhall Water.

B. pseudo-triquetrum, Schwaeg. East side of Newhall Water, Selkirk.

B. caespiticium L. Selkirk; Galashiels.

Mnium affine Bland. Roadside south of Galashiels.

M. undulatum L. East of Newhall Water.

Fontinalis antipyretica L. In stream south of Yarrow.

Neckera complanata Hubn. Bowhill.

Leucodon sciuroides Schwaeg. Selkirk; Bowhill.

Porotrichum alopecurum Mitt. Rocks by the Yarrow at Bowhill

Climacium dendroides W. & M. Selkirk; Tushielaw; Yarrow.

Brachythecium rivulare B. & S. Bowhill.

B. velutinum B. & S. Selkirk ; Galashiels.

B. populeum B. & S. Near Galashiels.

Eurhynchium myosuroides Schp. Selkirk ; east of Newhall Water.

E. striatum B. & S. Bowhill.

E. rusciforme Milde. Burns near Selkirk and Yarrow.

Plagiothecium denticulatum B. & S., var. **majus**, Boul. Bowhill (specimen determined by Mr. Meldrum).

P. silvaticum B. & S. East of Newhall Water.

Amblystegium serpens B. & S. Bowhill ; Galashiels.

Hypnum commutatum Hedw. and **H. palustre** Huds. Selkirk ; south of Yarrow.

Co. 78, Peebles.

(*a*) Additions to the Census Cat. list :—

Sphagnum cymbifolium Ehrh., var. **congestum** Schp. Moss south of Leadburn, Sept. 1904.

S. medium Limpr. Moss south of Leadburn, Sept. 1904.

S. Austini Sull. Moss south of Leadburn, Sept. 1904.
These three Sphagna were determined for me by Mr. Dixon.

Tetraphis pellucida Hedw. Macbiehill ; Whim, 1916 (J. C. Adam).

Polytrichum alpinum L. Hills between Eddleston and Moorfoot Water, March 1904.

P. formosum Hedw. Darnhall, Eddleston, Nov. 1916.

Pleuridium axillare Lindb. Portmore Loch, Oct. 1905.

Dicranella rufescens Schp. Portmore Loch, very abundant and fine, Oct. 1914. **D. varia** Schp. Medwyn Water, Aug. 1904.

Campylopus pyriformis Brid. This and *C. flexuosus* Brid. on moor south of Leadburn, May 1902.

Dicranum Bonjeani De Not. Between Dolphinton Station and West Linton, Aug. 1903 ; Darnhall.

D. majus Turn. Macbiehill ; Cowie's Linn, near Eddleston, April 1902.

Leucobryum glaucum Schp. Moor between Redfordhill and Cowie's Linn, April 1902 ; etc.

Grimmia trichophylla Grev. Whitfield, near Macbiehill, Feb. 1896.

Phascum cuspidatum Schreb. Fields at Macbiehill.

Tortula ruralis Ehrh. Old wall near Eddleston, Sept. 1904 ; Traquair, May 1917 ; near Broughton (J. Murray).

Barbula fallax Hedw. Near Cowie's Linn ; Fairliehope, Carlops.

B. spadicea Mitt. Medwyn Water, Aug. 1904.

B. vinealis Brid. Wall west of Carlops, May 1902 ; Eddleston.

Orthotrichum anomalum Hedw., near var. *saxatile* Milde, "but not quite" (Dixon). On wall west of Carlops, May 1902.

O. diaphanum Schrad. Near Broughton (J. Murray) ; Darnhall.

Splachnum sphaericum Linn. fil. Millstone-rig, Pentlands, Aug., and moss south of Leadburn, Sept. 1904.

Tetraplodon mnioides B. & S. Near source of the Medwyn, Peeblesshire side of co. boundary, July 1872. See Trans. Bot. Soc., xi, 456.

Funaria hygrometrica Sibth. Macbiehill ; Cowie's Linn ; etc.

Philonotis calcarea Schp. Near West Linton, Aug. 1903.

Bryum argenteum L. Eddleston ; Innerleithen, comn. May 1917.

B. roseum Schreb. Grassy bank at Innerleithen, Jan. 1897.

Mnium rostratum Schrad. Cowie's Linn, April 1902.

M. serratum Schrad. Cowie's Linn, April 1902 ; North Esk above Carlops, May 1902.

M. stellare Reich. Near Eddleston, 1915 (J. C. Adam).

M. subglobosum B. & S. Near West Linton, Aug. 1903. Probably this species, but no capsules were seen.

Fontinalis antipyretica L., var. **gracilis** Schp. Eddleston Water above Earlyvale, Oct. 1914.

Homalia trichomanoides B. & S. Macbiehill ; Cowie's Linn ; Darnhall.

Pterygophyllum lucens Brid. Near Carlops, 1902.

Leucodon sciuroides Schwaeg. Portmore, May 1902 ; Darnhall, Nov. 1916.

Pylaisia polyantha B. & S. Macbiehill, on trees, chiefly elm, Nov. 1873 and Feb. 1874, and on gooseberry bushes in garden, March 1875, etc. ; Portmore, on old hawthorn, 17th May 1902 ; all c. fr.

Camptothecium lutescens B. & S. Near Cowie's Linn, April 1902.

C. nitens Schp. Between Dolphinton Station and West Linton, Aug. 1903 and June 1904.

Brachythecium albicans B. & S. Lee Pen, Innerleithen, c. fr., Jan. 1897 ; near Cowie's Linn, April 1902.

Eurhynchium confertum Milde. Near Eddleston, April 1902.

Plagiothecium sylvaticum B. & S. Cowie's Linn, April 1902.

Amblystegium serpens B. & S. Macbiehill; Cowie's Linn; Darnhall.

A. irriguum B. & S. Rocks on both sides of the North Esk behind Carlops, May 1902. (Determined by Dixon.)

Hypnum fluitans L. Harlaw Moor west of Auchencorth, Oct. 1906.

H. commutatum Hedw. Near Innerleithen; Cowie's Linn.

H. cupressiforme L., var. **ericetorum** B. & S. Innerleithen; Darnhall.

H. molluscum Hedw., var. **condensatum** Schp. Cowie's Linn. (Named by Dixon.)

H. palustre Huds. North Esk above Carlops; Cowie's Linn.

H. stramineum Dicks. Medwyn Water, Aug. 1904; Harlaw Moor.

H. cordifolium Hedw. Wet meadow at Netherurd, July 1910.

H. giganteum Schp. Near Broughton (J. Murray); North Esk Reservoir above Carlops, Oct. 1914. I have a note of having seen a specimen many years ago from the head of Medwyn Water.

(*b*) Localities for some of the less common species recorded for the county in the Census Cat. :—

Oligotrichum hercynicum Lam. (*incurvum* Lindb.). Pentlands beside road west of North Esk Reservoir, Aug. 1904; Darnhall, Eddleston, Nov. 1916. Barren in both instances.

Polytrichum nanum Neck. Leithen Water, near Innerleithen, Jan. 1897.

Diphyscium foliosum Mohr. Near Broughton (J. Murray).

Cynodontium Bruntoni B. & S. Cowie's Linn, April 1902.

Dicranella squarrosa Schp. Leithen Water, c. fr., Jan. 1897.

Dicranodontium longirostre B. & S. Near Broughton (J. M.).

Dicranum fuscescens Turn. Lee Pen, Innerleithen, Jan. 1897.

Grimmia Doniana Sm. On rocks and "drystone" walls, Innerleithen Hills, Cowie's Linn, etc.

Rhacomitrium protensum Braun. Near Broughton (J. M.).

Tortula laevipila Schwaeg. Broughton (J. M.); Lamancha; Darnhall; Traquair.

Barbula rigidula Mitt. Near Broughton (J. M.).

Leptodontium flexifolium Hampe. South of Leadburn, April 1902; in fruit on hills between Eddleston and Moorfoot Water, March 1904.

Weisia rupestris C. M. Cowie's Linn, April 1902.

Cinclidotus fontinaloides P. Beauv. Near Broughton (J. M.).

Encalypta streptocarpa Hedw. Broughton (J. M.); wall at Carlops.

Zygodon viridissimus R. Br. Lamancha, April 1902; Darnhall. *Z. Mougeotii* and *T. tortuosum*, Medwyn Water.

Orthotrichum leiocarpum B. & S. Near Broughton (J. M.).

O. Lyellii H. & T. Lamancha; Darnhall; Traquair.

O. rivulare Turn. Near Broughton (J. M.).

O. stramineum Hornsch. Near Broughton (J. M.).

O. pulchellum Smith. Romanno Hill, Dec. 1872 (a fine specimen collected by my father); Portmore, May 1902.

Funaria ericetorum Dixon. On sides of surface drain on hillside, Leithen Water, Jan. 1897; near Broughton (J. M.).

Bartramia ithyphylla Brid. Cowie's Linn; Carlops.

Breutelia arcuata Schp. Cowie's Linn; Harlaw Moor.

Plagiobryum Zierii Lindb. Near Broughton (J. M.).

Bryum filiforme Dicks. Fairliehope, near Carlops, Aug. 1904.

Antitrichia curtipendula Brid. On old ash, Macbiehill, c. fr., July 1873,[1] and March 1875; Broughton (J. M.).

Heteracladium heteropterum B. & S. Cowie's Linn, 1902.

Brachythecium rivulare B. & S. Valley of Leithen Water in two places.

Eurhynchium piliferum B. & S. Broughton (J.M.); Darnhall.

Amblystegium fluviatile B. & S., and **A. filicinum** De Not. Near Broughton (J. M.). The latter also near Eddleston.

Hypnum falcatum Brid. Fairliehope, near Carlops.

H. Patientiae Lindb. Broughton (J. M.); roadside Harlaw Moor.

H. crista-castrensis L. Moor wood, Macbiehill, abundant, fruiting, Aug. 1872, May 1875, etc.

H. eugyrium Schp. Near Broughton (J. M.).

The following, and many other commoner species were collected at and near Cowie's Linn in April 1902:—*Grimmia apocarpa* var. *rivularis*.

Porotrichum alopecurum Mitt.; *Brachythecium plumosum* B. & S.; *Eurhynchium Swartzii* Hobk.; *Hypnum stellatum* Schreb.; *H. uncinatum* Hedw.; *H. ochraceum* Turn.; and *H. loreum* B. & S.

[1] This was recorded by me in Trans. Bot. Soc. Edin., xi, p. 520.

Co. 82, Haddington.

(*a*) Additions to the Census list. Some of these are mentioned in Mr. M'Andrew's paper (loc. cit.), but without localities: those in which he gives the localities are not repeated here. *Rhacomitrium protensum* (Traprain Law, Sept. 1908) occurred in a single patch about a foot square. Besides the locality given by Mr. M'Andrew for *Zygodon Mougeotii*, I have found it at Hailes, East Linton. The Sphagna, with the exception of *S. squarrosum*, were named "on the two systems" by Mr. Wm. Ingham, York:—

Sphagnum papillosum Lindb. var. **confertum** Lindb. Dunbar Common, Lammermuir Hills, 10th Oct. 1908.

S. rigidum Schp., var. **compactum** Schp. (=*S. compactum* De C., var. *imbricatum* Warnst.). Dunbar Common, Lammermuirs, Oct. 1908.

S. squarrosum Pers. Lammermuirs above Deuchrie, June 1914.

S. acutifolium Ehrh., var. **subnitens** Dixon (=*S. subnitens* Russ. & Warnst. var. *virescens* Warnst.). Dunbar Common, Lammermuirs, Oct. 1908.

S. acutifolium Ehrh., var. **rubellum** Russ. (=*S. rubellum* Wils., var. *versicolor* Warnst.). Dunbar Common, Lammermuirs, Oct. 1908.

S. cuspidatum Ehrh., var. **submersum** Schp. Dunbar Common, Lammermuirs, Oct. 1908.

Andreaea petrophila Ehrh. Traprain Law, Sept. 1908.

Polytrichum urnigerum L. Near Castle Moffat, Lammermuirs, Oct. 1908.

P. formosum Hedw. Garleton Hills, Sept. 1908; Castle Moffat.

Archidium alternifolium Schp. On side of ditch, Ormiston Hall, March 1902.

Pleuridium subulatum Rabenh. Near Oldhamstocks, April 1902.

Dicranella Schreberi Schp. In surface drains on the Lammermuirs above Blegbie, 28th June 1913.

D. squarrosa Schp. Lammermuirs above Deuchrie, Oct. 1908.

Campylopus flexuosus Brid. Lammermuirs above Castle Moffat, Oct. 1908.

Dicranum scoparium Hedw., var. **spadiceum** Boul. Garleton Hills, Sept. 1908.

Fissidens crassipes Wils. Wet rocks, river Tyne, East Linton, Sept. 1908. Identification confirmed by Mr. Dixon.

Tortula aloides De Not. Sea-braes near Skateraw, Feb. 1913.

Weisia verticillata Brid. Dunglass Dean, April 1902; coast east of Gullane, Oct. 1904.

Cinclidotus fontinaloides P. Beauv. Tyne at East Linton, Sept. 1908.

Orthotrichum pulchellum Smith. Ormiston Hall, March 1902.

Leptobryum pyriforme Wils. East Linton, in garden, May 1875; east side of Aberlady Bay, abundant, July 1898.

[**Webera annotina** Schwaeg. Mr. M'Andrew credits me with adding this species to the Haddingtonshire list, but I have no note of ever having gathered it in the county.]

W. carnea Schp.—Left bank of Tyne above Hailes Castle, in fine fructification, April 1913.

Bryum pseudo-triquetrum Schw., var. **compactum** B. & S. Specimen from Dirleton Links, Aug. 1897, was named by Mr. Dixon as this variety "probably."

Hypnum Wilsoni Schp. In old curling pond, Luffness Links, 7th Nov. 1908 (W. Edgar Evans and W. E.). Identification confirmed by Mr. Dixon.

H. fluitans L. Lammermuirs, on Dunbar Common, Oct. 1908, and above Blegbie, June 1913.

H. cupressiforme L., var. **elatum** B. & S. Dirleton sandhills, Jan. 1897.

H. Patientiae Lindb. Roadside at Boltonmoor, March 1904; near Castle Moffat, Oct. 1908.

H. stramineum Dicks. Dunbar Common, Lammermuirs, Oct. 1908.

(*b*) Localities for some of the species recorded for the county in the Census Cat.:—

Polytrichum gracile Dicks. Boltonmoor, May 1910.

Ditrichum homomallum Hampe. Ormiston Hall Woods, March 1902; near Castle Moffat, Oct. 1908; Binning Wood, Tyninghame, May 1911.

Cynodontium Bruntoni B. & S. Garleton Hills, c. fr., Sept. 1908.

Dichodontium pellucidum Schp. Lammer Law, Oct. 1902; Banks of Gifford Water, Yester, Jan. 1904.

Dicranella varia Schp. Ormiston Hall Woods, March 1902.

Dicranoweisia cirrata Lindb. Garleton Hills, Sept. 1908.

Campylopus pyriformis Brid. Garleton Hills, Sept. 1908.

C. fragilis B. & S. Gifford, Oct. 1916.

Dicranum Bonjeani De Not. Dirleton Common, Aug. 1897; Garleton Hills; Lammermuirs above Yester.

D. majus Turn. Ormiston Hall, March 1902; Boltonmoor Wood, Aug. 1909.

Leucobryum glaucum Schp. Occurs not only on the Lammermuirs, where it is common, but also close to the sea in Tyninghame fir-woods (Aug. 1914).

Fissidens pusillus Wils. Dunglass Dean (west side), April 1902.

F. osmundoides Hedw. Traprain Law, c. fr., Sept. 1908.

Pottia Heimii Fürnr. Luffness Links, Aug. 1898.

Tortula rigida Schrad. Wall-top near Tranent, 1844 (specimen from my father's collection).

T. mutica Lindb. On old stump by the Tyne at Haddington, Oct. 1906.

T. laevipila Schwaeg. Eaglescairnie, April 1905; Yester; Ormiston; etc.

T. intermedia Berk.—Dirleton Links, on rock, Aug. 1898; Longniddry, Feb. 1901; wall at Amisfield, Haddington, Sept. 1908.

T. ruralis Ehrh. Dirleton, Aug. 1897; Pressmennan, on roof of boat-house. The sub-species, *T. ruraliformis*, is very common on the sand-dunes between North Berwick and Longniddry.

T. papillosa Wils. Eaglescairnie, on old tree, April 1905; Spott, near Dunbar, on sandstone rock, Nov. 1913.

Barbula tophacea Mitt. Sides of ditch on Gullane Links; Dunglass Dean.

B. cylindrica Schp. Humbie Water, May 1903; Saltoun, Dec. 1906. *B. fallax* also at Saltoun, etc.

B. vinealis Brid. On wall at Prestonpans, June 1916.

B. convoluta Hedw. Old road, Boltonmoor, March 1904; Gullane Hill, Dec. 1906.

Weisia curvirostris C. M. Near the waterfall at Billsdean, E. Lothian (J. Hardy, Moss Fl. East. Borders, 1868). This is the Census Cat. record.

Encalypta vulgaris Hedw. Prestonpans; old quarry near Gullane, 1916 (J. C. Adam).

E. streptocarpa Hedw. Near Saltoun Hall, on old wall, abundant, Dec. 1906.

Zygodon viridissimus R. Br. Yester, Jan. 1902; Eaglescairnie; Luffness.

Ulota crispa Brid. Boltonmoor Wood, c. fr., on oak, March 1904. *U. Bruchii* I have also gathered in this locality, and in a good many others in the county.

U. phyllantha Brid. Boltonmoor Wood, on oaks, March 1904.

Orthotrichum rupestre Schleich. North Berwick Law, Aug. 1897; Hailes, near East Linton, Sept. 1908.

O. leiocarpum B. & S. Saltoun, May 1904. The 82 records for this species and *O. cupulatum* are based, I understand, on specimens from Dirleton, in the Herbarium, Royal Botanic Garden, Edinburgh.

O. Lyellii H. & T. Yester; Eaglescairnie; West Saltoun.

O. diaphanum Schrad. On ash, West Saltoun, Dec. 1906; on wall, Luffness; on elder, Seacliff and Port Seton.

Physcomitrium pyriforme Brid. Gosford, May 1890; left bank of Tyne above Hailes Castle, April 1913.

Amblyodon dealbatus P. Beauv. Luffness and Gullane Links on many occasions; particularly plentiful in June 1909. *Meesia trichoides* is now very rare in this station; I last saw it there in May 1909.

Aulacomnium palustre Schwaeg. Luffness Marsh; Dunbar Common, Lammermuirs.

Catoscopium nigritum Brid. Gullane Links, large fruiting patches in July 1897 and June 1909; the best spots for it have, however, now been destroyed by the extension of the golf course on the hill. Gullane Links has long been known as a locality for this interesting plant; I find it noted by my father in 1846, and it is mentioned in Stark's little book on British Mosses.

Philonotis calcarea Schp. Luffness Marsh, male "flowers" abundant, but only a few capsules, July 1898.

Webera cruda Schwaeg. Garleton Hills and Traprain Law.

W. albicans Schp. Deuchrie at foot of Lammermuirs.

Bryum Warneum Bland. Gullane Links, July 1897. Specimens with capsules in good state for examination were determined for me by Mr. Dixon.

B. calophyllum R. Br. Gullane Links, July 1897, barren (H. N. Dixon, who kindly gave me a specimen), and Nov. 1908.

B. uliginosum B. & S. In damp hollow, Dirleton Links, 11th Aug. 1897. Identified for me by Mr. Dixon. *B. pendulum* and *B. inclinatum* are both common on the Gullane, etc., Links.

B. pallens Sw. Oldhamstocks, April 1902.

Mnium cuspidatum Hedw. Dirleton Common, Jan. 1897; a small patch coming into fruit.

M. rostratum Schrad. Ormiston Hall; Saltoun; Yester; Dunglass.

Cryphaea heteromalla Mohr. The only East Lothian record I know of is that by J. Hardy from Dunglass Pond (Moss Fl. East. Bord., 1868).

Leucodon sciuroides Schwaeg. On rocks at Hailes, near East Linton, Sept. 1908 and other dates ; Yester, on poplar, Jan. 1904.

Pterogonium gracile Swartz. Rocks at Hailes, on several occasions.

Antitrichia curtipendula Brid. On an old tree, Yester, Aug. 1902.

Porotrichum alopecurum Mitt. Oldhamstocks Burn ; Ruchlaw.

Climacium dendroides W. & M. Gullane Links ; Lammermuirs above Castle Moffat, etc.

Camptothecium lutescens B. & S. Dirleton Common, Jan. 1897 ; Gullane Links, Oct. 1905.

Brachythecium glareosum B. & S. East of Port Seton (from J. M'Andrew, Nov. 1906). *B. albicans*, common on coast dunes.

B. rivulare B. & S. Above Castle Moffat, Oct. 1908.

Eurhynchium piliferum B. & S. Ormiston Hall Woods, March 1902. *E. striatum*, *E. myosuroides*, and *B. populeum* were also collected at same time.

E. Swartzii Hobk. Dirleton Common ; Humbie.

E. tenellum Milde. Shaded wall east of Port Seton, May 1907.

Plagiothecium elegans Sull. Ormiston Hall Woods ; Dunglass Dean ; Garleton Hills.

Amblystegium Juratzkanum Schp. On sand-covered stem of saugh growing over the Birns Water, near Humbie Station, May 1903 ; also, though not quite typical, on similar habitat near Drem, Dec. 1904. Specimens from both localities were determined by Mr. Dixon.

A. filicinum De Not. Castle Moffat ; West Saltoun ; sea-braes near Skateraw.

Hypnum stellatum Schreb. Luffness Marsh ; Skateraw ; etc.

H. chrysophyllum Brid. Gullane Links, Nov. 1908.

H. uncinatum Hedw. Traprain Law ; Upper Bolton.

H. falcatum Brid. Luffness Marsh ; sea-braes near Skateraw.

Hylocomium loreum B. & S. In fine "fruit," Boltonmoor Wood March 1904 ; also at Yester, Castle Moffat, Garleton Hills, etc.

Co. 83, Edinburgh.

Greville, Sadler, and others have provided records for a very comprehensive list of the Mosses of this county, the vicinity of Edinburgh having long been a happy hunting-ground for local botanists interested in this section of our flora. My own interest in the subject began in 1868 when, with Greville's Flora Edinensis as my reference book, I explored the valley of the Esk about Penicuik and the recesses of the Pentland Hills, including the "cryptogamic garden" above the waterfall at Nether Habbie's Howe. Since then the Mosses of the district have

again and again claimed my attention, leading to the frequent repetition of these health-giving and inspiring rambles. The result of all this has been the accumulation of a large amount of material bearing on the distribution of the various species in the county, and the changes in their status which time has brought about. For its proper treatment, however, this pile of data would require a separate paper, and in the present communication only a selection of the more outstanding of my records are given.

(*a*) Additions to the Census Cat. list :—

Polytrichum strictum Banks. Moss west of Ravelrig, Balerno, May 1909. In October of same year it was found on Bavelaw Moss by Mr. M'Andrew (loc. cit.) "Pentlands" is given as a locality for it in Balfour and Sadler's Flora of Edinburgh.

Dicranella heteromalla, var. **orthocarpa** Hedw., "or very near it" (Dixon). Ravelrig, near Balerno, April 1898.

Campylopus flexuosus, var. **paradoxus** Husn., "or very near it" (Dixon). Moss west of Ravelrig, April 1898.

Trichostomum tortuosum, var. **fragilifolium** Dixon. Torduff, Pentlands, March 1898. Determined by Mr. Dixon.

Orthotrichum affine, var. **fastigiatum** Hubn. On wall, Fairmilehead, June 1897.

Physcomitrella patens B. & S. This little moss was abundant at the upper end of Torduff Reservoir and also at Clubbiedean Reservoir, Pentlands, in Oct. 1908—as recorded by my son, W. Edgar Evans, in Ann. Scot. Nat. Hist. for 1909, p. 55—and on other occasions.

Webera proligera Bryhn. I have seen a specimen from Roslin Glen, taken by Mr. J. C. Adam in 1916.

Cryphaea heteromalla Mohr. This curious moss is not given for Co. 83 in the Census Catalogue. I may therefore point out that in Balfour and Sadler's Flora of Edinburgh (1863, and 2nd ed. 1871) Dalkeith is given as a locality for it.

(*b*) Localities for some of the better species in the Census Cat. list. Many are additions to the list in Balfour and Sadler's Flora of Edinburgh :—

Sphagnum Austini Sull. Auchencorth Moss, 24th May 1902.

Polytrichum gracile Dicks. Kirknewton ; Ravelrig and Auchencorth Mosses ; etc. *P. formosum*, Ravensnook, Dreghorn, Polton, etc.

Archidium alternifolium Schp. Side of Bonaly Reservoir, April 1898 ; Harelaw Dam ; Glencorse and Cobbinshaw Reservoirs.

Swartzia montana Lindb. On old wall, Balerno, 7th March 1894.

Seligeria Doniana C. M. On sandstone rocks, Dryden (Bilston) Glen, near Roslin, 4th April 1902.

Brachyodus trichodes Fürnr. On sandstone by side of rill at the wood skirting the moor above Currie, 15th March 1904.

Dicranella cerviculata Schp. Moor east of Cobbinshaw, abundant, Aug. 1904; south side of the Almond, Craigiehall, Dec. 1904.

D. secunda Lindb. On old cart-track, Threipmuir Reservoir, May 1898; edge of Bavelaw Moss, June 1901

D. Schreberi Schp. Allermuir Glen, Pentlands, March, and *V. elata*, Ravensnook, near Penicuik, May 1902. Briech Burn, given in Balfour and Sadler's Flora of Edinburgh as a locality for this species, leaves the county—Midlothian or Linlithgow—uncertain.

Campylus fragilis B. & S. Water of Leith below Harperrig, Nov. 1897; Torduff, Pentlands, March 1898; Caerketton, Pentlands, April 1909 (W. Edgar Evans).

Dicranum Bonjeani De Not. I have only once found capsules of this common moss in this district, namely, at the upper pond, Penicuik House, in May 1871. *D. fuscescens*, Caerketton, etc.

D. strictum Schleich. On sycamores, oaks, etc., in Roslin, Hawthornden, and Dryden Woods on many occasions since I first added it to the Scottish list from Roslin Glen in April 1898 (see Ann. Scot. Nat. Hist., 1902, p. 191). Pomathorn Dean.

Fissidens exilis Hedw. South bank of Water of Leith, Redhall, Colinton, abundant, Feb. 1897; Dreghorn, March 1897.

F. pusillus Wils. Vogrie Glen, on sandstone rock, abundant, Feb. 1897; Bilston Glen, April 1902; on sandstone wall, near Balerno, Oct. 1908 (W. E. Evans).

F. decipiens De Not. In April 1897 I got a Fissidens at Nether Habbie's Howe, Pentlands, which Mr. Dixon determined as this species. Localities for *F. osmundoides* are Moorfoot Water, March 1904, and Dalmahoy Hill, May 1907.

Grimmia Stirtoni Schp. On low rocks, Boghall, Pentlands, March 1902.

G. ovata Schwaeg. Rocks on Braid Hills, in fine fructification, Feb. 1869 and Dec. 1908. In June 1871 I gathered on Arthur's Seat most of the rare Grimmias that had been recorded therefrom, and some of them were still in evidence in March 1902; but it is doubtful if any now remain.

Pottia recta Mitt. In flower-pot in greenhouse, Morningside Park, Edinburgh, Sept. 1904.

P. intermedia Fürnr. Wall top beyond Liberton, Dec. 1878.

P. minutula Fürnr. Near Currie, Feb. 1897. *P. lanceolata* used to be common on an earth-capped wall at Craiglockhart, and was very fine on an old wall near Craigmillar in the spring of 1904.

Tortula pusilla Mitt. Roadside at Fordel, near Prestonhall, abundant, Jan. 1915. This and *T. rigida* used also to occur commonly on earth-capped walls at Craiglockhart now taken down or destroyed. My latest date for them there is April 1909.

T. ambigua Ångstr. South side of glen at Roslin, Oct. 1897; in old quarries at Blackford Hill and Craigmillar. *T. aloides*, in old limestone quarry at Gilmerton, March 1902.

T. mutica Lindb. On old saugh, river Esk at Inveresk, Feb. 1903.

T. intermedia Berk. On rocky ground, Braid Hills, May 1877. *T. ruraliformis* has been found at Levenhall Links, Musselburgh; *T. laevipila* on old sycamores at Arniston, Woodhouselee, etc.; *T. princeps* on wall at Craiglockhart, March 1877, and Nether Habbie's Howe, April 1897; *T. papillosa* on rocks on Braid Hills, April 1905.

Barbula spadicea Mitt. Torduff, April 1898; Cramond. *B. rigidula*, Kirknewton, Swanston, etc. *B. lurida*, Gilmerton, 1902.

B. cylindrica Schp. Ravelrig, Balerno, c. fr., April 1898; Edgelaw Glen, on wet rock, June 1902; on old wall near Dalkeith, abundant and fruiting freely, April 1905. The subspecies *B. vinealis* has for many years grown in profusion on a wall at Balerno.

B. convoluta Hedw. Side of Bonaly Reservoir, April 1898.

Leptodontium flexifolium Hampe. Caerketton (south side) and Bonaly Hill, Pentlands.

Weisia tenuis C. M. On sandstone rocks, right bank of Almond below Cramond, Feb. 1905, and Bilston Glen, April 1909. *W. mucronata* was common in an old quarry at Ravelston in Feb. 1904. *W. verticillata*, Currie, June 1856 (Balfour's Excursions); near Cramond, Dec. 1903.

Cinclidotus fontinaloides P. Beauv. Almond below Cramond Brig, March 1902; Glencorse Reservoir, Dec. 1904.

Encalypta vulgaris Hedw. In 1824 Greville wrote of this: "extremely abundant on the mud-capped walls by the roadsides round Edinburgh," and it was still common thirty to forty years ago; now that these walls are practically a thing of the past, I seldom see it. Fairmilehead and Crichton, 1897; Ratho; Little France, 1905; Craiglockhart, 1909. *E. streptocarpa* has, on the other hand, become much more plentiful. Greville gave only rocks, Pentland Hills and west side of Arthur's Seat, for it; now it is abundant on shady stone-and-lime walls at Gilmerton, Penicuik, Vogrie, Balerno, Dalmahoy, etc., but never seems to produce capsules. *E. ciliata* still occurs at Nether Habbie's Howe, but in greatly reduced quantity; and this also applies to most of the other good mosses found there. *E. ciliata* and some others were still in Bonaly Glen less that twenty years ago.

Zygodon Stirtoni Schp. Rocks in Craiglockhart Wood, c. fr., March 1902. *Z. Mougeotii* occurred in Moorfoot Glen (along with *Andreaea petrophila*, *Weisia rupestris*, etc.) in March 1904; and near Nine-Mile Burn in May 1902. Localities for *Z. viridissimus* are Penicuik, Newhall, Arniston, Craigmillar, etc.

Ulota Drummondii Brid. On ash and hazel, Edgelaw Reservoir, June 1902, along with *U. crispa*, var. *intermedia*. *U. phyllantha* Brid., on boulder east of Cramond, May 1902. *U. Bruchii* is our commonest species of the genus.

Orthotrichum stramineum Hornsch. Little Vantage, Penicuik, Polton. *O. Lyelli*, Penicuik, Arniston, Heriot, etc. *O. diaphanum*, Braid Hills, Craigmillar, Ravensnook. *O. pulchellum*, Penicuik, Edgelaw. *O. leiocarpum*, Penicuik, Arniston.

Splachnum sphaericum Linn. fil. Bavelaw Moss, April 1878, etc.; Bonaly Hill, Currie Moor, Swanston Hill, etc.; East Cairn Hill, Sept. 1905. I have a specimen of *S. ampullaceum* from Ravelrig bog, collected by my father in July 1847.

Tetraplodon mnioides B. & S. Ridge between Scaldlaw and South Black Hill, Pentlands, 23rd May 1891 (see Ann. Scot. Nat. Hist., 1894, p. 187), and once since; Bavelaw Moss, June 1895 and 1897.

Funaria ericetorum Dixon. On side of surface-drain, Allermuir Glen, Pentlands, March 1902. From Mr. M'Andrew I understand that *F. Templetoni* was erroneously given for Co. 83 in the Census Cat. owing to a mistake regarding the locality.

Aulacomnium androgynum Schwaeg. Arniston Woods, June 1848 (from my father's collection) and Oct. 1902; in small ravine near Nether Habbie's Howe, Pentland Hills, May 1868 (W. E. in Trans. Bot. Soc. Edin., xi, p. 456); near Auchendinny (J. M'A.).

Bartramia ithyphylla Brid. Nether Habbie's Howe, April 1897; Heriot, May 1901; Moorfoot Water, March 1904.

Philonotis calcarea Schp. Fullarton Water, Nov. 1897; Pentlands above Bonaly, July 1898; Polton, May 1904.

Orthodontium gracile Schwaeg. Several places in Roslin Glen, March 1900, etc. First recorded from this locality by Messrs. Scott and Murray in 1898 (Ann. Scot. Nat. Hist. and Trans. Edin. Field Nat. Soc.).

Webera commutata Schp. On old cart-track, Threipmuir Reservoir, May 1898. Mr. M'Andrew gave me Fountainhall Quarry, Ravelston, April 1904, as a locality for *W. annotina*. I have *W. albicans* from Penicuik, Arniston, Roslin, Bonaly Hill, etc.; and *W. carnea* from Penicuik, Polton, and Dalhousie.

Plagiobryum Zierii Lindb. Still exists at Nether Habbie's Howe; ravine west of Swanston, Feb. 1898.

Bryum filiforme Dicks. Moorfoot Water, March, and Bonaly Glen, Oct. 1904. Localities for *B. pallens* are Penicuik, Loganlee; Polton, Moorfoot Water, and Harburn; and for *B. bimum*, Allermuir Burn, Pentlands, Dec. 1900; Bonaly Glen, Oct. 1904.

B. intermedium Brid. South bank of Esk at Roslin, Oct. 1897.

B. alpinum Huds. Roadside west of Balerno, March 1894, etc.; Dalmahoy Hills, April 1899; Nether Habbie's Howe, April 1902.

B. roseum Schreb. Penicuik Woods, Nov. 1868; Craiglockhart, March 1902; Arniston, Oct. 1905.

Mnium affine Bland. At foot of wall, Morton, March 1898.

M. Stellare Reich. Craiglockhart Wood, March 1902.

M. subglobosum B. & S. Pentlands west of Swanston, in fine fruit, 1st Jan. 1897, etc.; Bonaly Hill and Dalmahoy Wood, 1898; head of Logan Water, April 1902.

Fontinalis antipyretica L., var. **gracilis** Schp. Gutterford Burn, Pentlands, Oct. 1905.

Neckera crispa Hedw. I fear this fine moss no longer grows at Nether Habbie's Howe; my last date for it there is April 1902. In 1899 there was still a very little of it in Bonaly Glen.

Pterygophyllum lucens Brid. Penicuik and Dryden Woods; Fullarton Water; etc.

Leucodon sciuroides Schwaeg. Arthur's Seat, June 1871; Blackford Hill; Arniston and Rosebery; Craiglockhart; Craigmillar.

Pterogonium gracile Swartz. Blackford Hill, last seen in 1900; Braid Hills; Craiglockhart, March 1902. So long ago as 1792 it was recorded from Arthur's Seat by Lightfoot.

Antitrichia curtipendula Brid. Penicuik, on an old sycamore, c. fr., 1869, etc. On revisiting this locality about twenty years ago, I found the tree gone.

Leskea polycarpa Ehrh. On willows and stones, Glencorse Reservoir, Dec. 1904, etc.

Anomodon viticulosus H. & T. Still exists, or did so a few years ago, at Craigmillar Castle and Craiglockhart.

Heterocladium heteropterum B. & S. Roslin Glen, March 1900; var. *fallax*, Bilston Glen, Feb. 1903.

Orthothecium intricatum B. & S. Still at Nether Habbie's Howe; Torduff, last seen March 1902; foot of Glencorse Reservoir, Sept. 1901.

Camptothecium nitens Schp. Fullarton Water, above Edgelaw, 21st April 1870; near head of Logan Water, Pentlands, Nov. 1903, etc.; north side of Carnethy, Oct. 1904. Records for *C. lutescens*, B. & S., are Vogrie Glen, in profusion and fruiting abundantly, Feb., Bonaly Hill, March, and Fullarton lime-quarries, Nov. 1897; Gilmerton, March 1902.

Brachythecium salebrosum B. & S., var. **palustre** Schp. Ditch by side of Threipmuir Reservoir, c. fr., Dec. 1899.

B rivulare B. & S. Bonaly Glen, June, and Fullarton Water, Oct. 1898; side of Carnethy, Oct. 1904; well-head, Allermuir Burn, April 1909.

Eurhynchium crassinervium B. & S. Braid Hermitage; Craiglockhart Hill Wood, June 1902. *E. Swartzii* Hobk., Craigmillar, and near Loanhead, Jan. 1897. *E. murale* Milde, wall at Braidburn, but disappeared a good many years ago; Gilmerton Quarry; Dalkeith, April 1905. *E. tenellum*, Craiglockhart, 1902.

Plagiothecium depressum Dixon. Bilston Glen, April 1902. *P. elegans* Sull., Polton Woods, April 1898, etc.; Penicuik Woods, May 1911; Caerketton.

Amblystegium irriguum B. & S. East bank of Esk at Carlops, May 1902. *A. fluviatile* B. & S., Water of Leith near Donaldson's Hospital. *A. filicinum* De Not., Dalhousie Burn ; Allermuir Burn ; Bush, near Roslin.

Hypnum stellatum Schreb. Pentlands, c. fr., April 1868 ; Pomathorn Moor, c. fr., May 1869, etc. ; var. *protensum*, walls near Kirknewton, etc. ; Gilmerton Quarry, March 1902.

H. chrysophyllum Brid. Allermuir Glen, Pentlands, Dec. 1900.

H. fluitans L. Auchencorth Moss, in fine fruit, June 1885 ; Castle Law, Pentlands, etc. *H. uncinatum*, Corstorphine Hill ; Newpark, etc.

H. falcatum Brid. Bonaly Glen, June 1898, south side of Carnethy and elsewhere on the Pentlands.

H. cupressiforme L., var. **resupinatum** Schp. Braid Hills, c. fr., May 1877 ; Craiglockhart Hill ; Hawthornden. Var. *ericetorum* B. & S. is common on the Pentlands.

H. Patientiae Lindb. Loganlee, Pentlands, 1897, etc. ; Harperrig, Oct. 1905.

H. crista-castrensis L. Bavelaw fir-wood, May 1898, etc.

H. eugyrium Schp. Clubbiedean, March, and Nether Habbie's Howe, April 1897. *H. ochraceum* Turn. is common in the Logan Water, Gutterford Burn, Crosswood Burn, etc., on the Pentlands.

H. scorpioides L. Pomathorn Moor, May 1869.

H. stramineum Dicks. Loganlee, Pentlands, c. fr., May 1869, etc. ; Bavelaw Moss, Aug. 1898, etc. ; *H. cordifolium* Hedw., Duddingston Loch, c. fr., April 1878 ; near Bavelaw ; Ravensnook.

My Co. 84 (Linlithgowshire) records, in so far as they are additions or relate to the less common species, are, as previously mentioned, incorporated in Mr. Adam's list (*antea*, p. 123).

I have also a large number of records from Vice-Co. 85 (Fife with Kinross) and Vice-Co. 87 (West Perth with Clackmannan), but these are outside the scope of this paper. Allusion, however, may be made to the occurrence of **Dicranella curvata* Schp. in an old limestone quarry on Bishop Hill, Lomonds, April 1904 ; of *Andreaea alpina* Smith, **Hedwigia imberbis* Spruce, *Grimmia decipiens* Lindb., and **Trichostomum mutabile* Bruch, on the Ochils near Alva, May 1897 ; *Rhabdoweisia fugax* B. & S., *Splachnum vasculosum* L., *Bryum Duvalii* Voit, *Orthothecium rufescens* B. & S. on south side and *Oligotrichum hercynicum* Lam. on summit of Ben Cleuch, Ochils, May 1904 ; *Diphyscium foliosum* Mohr, *Rhabdoweisia denticulata* B. & S., *Campylopus atrovirens* De Not., *Rhacomitrium protensum* Braun, **Bryum bimum* Shreb. and *Hypnum sarmentosum* Wahl. on Ochils behind Dollar, April 1897 ; **Camptothecium lutescens* B. & S. and *Eurhynchium crassinervium* B. & S. behind Menstrie. April 1909 ; and **Hypnum cordifolium* Hedw., near Tullibody, May 1909, Those marked * are additions to the Census lists. *S. vasculosum*, it should be said, was recorded from King's Seat Hill, Ochils, in July 1891 by Dr. Buchanan White (Proc. Perth. Soc. Nat. Sc., I, cxxvi). For some Isle of May records see Trans. Bot. Soc. Edin., xxiii, p. 348 and xxiv, p. 91.

APPENDIX.

Further Additions to the Selkirkshire List.

Since the foregoing paper was drawn up I have collected the following twelve additions to the Co. 79 list at Selkirk, namely :—

Ditrichum flexicaule Hampe. On calcareous bank at roadside south of Selkirk.

Barbula rigidula Mitt. On old wall near Selkirk.

B. revoluta Brid. On wall close to Selkirk.

B. convoluta Hedw. Roadside near Selkirk.

Tortula laevipila Schwaeg. On elm near Selkirk.

Encalypta streptocarpa Hedw. On wall in Selkirk and on rocky bank by roadside south of the town.

Orthotrichum stramineum Hornsch. On sycamore at roadside near Selkirk.

Bryum argenteum L. Common on footpaths in Galashiels and Selkirk and on field-path near the latter town.

Brachythecium glareosum B. & S. On calcareous bank at roadside south of Selkirk.

Eurhynchium Swartzii Hobk. In field near Selkirk.

Amblystegium filicinum De Not. In marshy ground beside pond near Selkirk.

Hypnum falcatum Brid. In same locality as the last.

Specimens of these further additions have been submitted to Mr. Meldrum.

In 1909 Mr. S. M. Macvicar collected a number of Mosses in the upper part of Yarrow, among them being the following further additions to the county list :—*Sphagnum rigidum* Schp., *S. intermedium* Hoffm., *Andreaea petrophila* Ehrh., *A. Rothii* W. & M., *Dichodontium pellucidum* Schp., *Fissidens decipiens* De Not., and *Zygodon Mougeotii* B. & S. (J. M'Andrew, in lit., 12th July 1909).

Funaria ericetorum and *Bryum filiforme* were collected by me near Selkirk, Aug. 1903, and at Crosscleuch Burn, near St. Mary's Loch, Aug. 1907 respectively, and are both included in the Census list.

It might have been thought that the romance of Yarrow would have drawn more bryologists to explore its "Braes" and "Dowie Dens."

Rhododendrons of the Irroratum Series. By Professor Bayley Balfour, F.R.S.

(Read 8th February 1917.)

The series of Rhododendrons which we may call Irroratum, after the first described species included in it, has a wide area of distribution in Yunnan, and to our present knowledge extends only into Eastern Upper Burma over the Yunnan frontier. Its extreme limits in Yunnan as known are Mengtsz in the south-east, Tengyueh in the west, Tseku in the west-north-west, and the Chungtien plateau in the east-north-west. Fourteen species of the series are known. The following list gives their names, the distribution of each, and the name of its discoverer:—

Rh. adenostemonum, Balf. f. et W. W. Sm.	S.E. Yunnan.	N. of Mengtsz. 8500 ft. (Henry.)
Rh. agastum, Balf. f. et W. W. Sm.	W. Yunnan.	Shweli-Salween divide. 7000–9000 ft. (Forrest.)
Rh. anthosphaerum, Diels.	E.N.W. Yunnan.	Sungkwei pass. 10,000–11,000 ft. (Forrest.)
Rh. araiophyllum, Balf. f. et W. W. Sm.	W. Yunnan.	Shweli-Salween divide. 9000–10,000 ft. (Forrest.)
Rh. ceraceum, Balf. f. et W. W. Sm.	W.N.W. Yunnan.	Tseku. (Monbeig.)
Rh. eritimum, Balf. f. et W. W. Sm.	E.N.W. Yunnan.	Chungtien plateau. 9000 ft. (Forrest.)
Rh. gymnanthum, Diels.	W.N.W. Yunnan.	Tseku. 13,000 ft. (Forrest.)
Rh. hylothreptum, Balf. f. et W. W. Sm	E.N.W. Yunnan.	Sungkwei pass. 11,000–12,000 ft. (Forrest.)
Rh. irroratum, Franch.	Mid. N.W. and E.N.W. Yunnan.	Tali range to the Chungtien plateau. 9000–12,000 ft. (Delavay.)
Rh. lukiangense, Franch.	W.N.W. Yunnan.	Tseku. (Soulié.)
Rh. mengtszense, Balf. f. et W. W. Sm.	S.E. Yunnan.	S.E. of Mengtsz. 7000 ft. (Henry.)
Rh. pogonostylum, Balf. f. et W. W. Sm.	S.E. Yunnan.	N. of Mengtsz. 7000–8500 ft. (Henry.)
Rh. spanotrichum, Balf. f. et W. W. Sm.	S.E. Yunnan.	Fengchenlin Mts., S.W. of Mengtsz. 7500 ft. (Henry.)
Rh. tanastylum, Balf. f. et Ward.	E. Upper Burma.	Hpimaw. 9000–10,000 ft. (Ward.)

Two of these species are in cultivation—*Rh. hylothreptum* and *Rh. irroratum*. A third plant belonging to the series

was also in cultivation, and flowered at Kew in 1907, but it has not yet been described.

The specimens of the series which I have had for examination are far from complete. Of one only is there certainly fruit. In only four species are the important foliage-bud stage and the unfolding young leaves present. I cannot hope in the circumstances to give an exhaustive account of the species, but it may help the progress of our knowledge if I state what I know of them, imperfect though the statement must be.

The plants are shrubs or small trees reaching a height at maximum of some 9 meters, with usually not very thick terminal branchlets—sometimes these are quite thin (*Rh. araiophyllum*). The shoots after the juvenile stage appear to be glabrous in most species and are commonly so described, but in *Rh. pogonostylum* an indumentum covers the one-year old stems. Glabrescent would be the more correct term. The leaves with short petioles from 1·5–2 cm. long (barely 1 cm. *Rh. eritimum*, 1 cm. only *Rh. araiophyllum*) are lanceolate, oblanceolate or oblong, have a cartilaginous margin flat or slightly recurved and always more or less undulate, sometimes notched sometimes only asperate. The leaf apex in the lanceolate and oblanceolate forms tapers to a longish point, in the oblong forms (*Rh. agastum*, *Rh. eritimum*) is more or less suddenly contracted into a beak-like extremity; the midrib runs out in all to the end of the leaf and enlarges into a small horny hydathodal tubercle which, conspicuous in young leaves and forming a distinct mucro, is in the old leaves overgrown as it were by the lamina and covered by it. The base of the leaf is cuneate or narrowly obtuse in the lanceolate forms, more broadly obtuse in the oblong, quite rounded in *Rh. pogonostylum*. The upper surface may be glaucous green (*Rh. adenostemonum*, *Rh. gymnanthum*, *Rh. irroratum*), more commonly an olive green, sometimes showing a reddening along the course of the midrib and primary veins (*Rh. ceraceum*); sometimes in the older leaf becoming quite a dark brown (*Rh. adenostemonum*). The under surface is more variable, passing from glaucous (*Rh. eritimum*) through straw-coloured (*Rh. pogonostylum*, *Rh. spanotrichum*) and fawn

(*Rh. anthosphaerum*, *Rh. irroratum*) to tawny shades (*Rh. agastum*, *Rh. araiophyllum*, *Rh. ceraceum*, *Rh. hylothreptum*, *Rh. lukiangense*, *Rh. mengtszense*, *Rh. tanastylum*) to cinnamon (*Rh. adenostemonum*). Apparently several shades may be exhibited by one species according to age. Three species stand out from their fellows by the particularly glossy character of the leaf-surface due to a wax coating. *Rh. gymnanthum* has the upper surface as if polished—a useful character for discriminating it at sight from *Rh. mengtszense* in which the form of foliage though larger is somewhat similar,—and *Rh. ceraceum* and *Rh. lukiangense* have the under surface as if varnished. *Rh. araiophyllum*, *Rh. mengtszense*, *Rh. spanotrichum*, and *Rh. tanastylum* have also the under surface somewhat glossy. Wax is, I believe, an epidermal formation in all species of the section, only making itself conspicuous by giving a glossy aspect in these cases I am naming here. For a study of its development growing plants are required. The poisoning of herbarium specimens with alcoholic solutions must alter the appearances. As it appears the wax is an infiltration of the outer cuticle out of which it can be dissolved by benzole or other suitable solvent. This is a different relation from that in species where the leaf surface has a white or grey bloom, *e.g.* in *Rh. formosum* or in the Lapponicum series. There epidermal papillae are developed standing out from the leaf surface, and upon the outside of these white wax granules cluster. There is no varnishing of the surface as there is here in the Irroratum series. One surface (the under) or both surfaces are to correct observation conspicuously although minutely punctulate in all species save perhaps in *Rh. ceraceum* and *Rh. lukiangense*. Apparently *Rh. araiophyllum* has no punctulations on the under surface apart from the midrib and veins. Minute red or orange spots are distributed on midrib, primary veins, and the general reticulation of the surface, and these may be seen also on the cartilaginous margin. For an understanding of this feature we must go to the buds and the young leaves as they expand. The ptyxis of the leaves is revolute, the young leaves standing in a cluster in the middle of the bud-chamber after the fashion in all the large-leaved

evergreen species of Rhododendron. The revolution of the lamina makes the upper surface the exposed one, excepting the midrib (here raised) of the under surface against which the curled sides of the lamina abut. The upper surface and the exposed midrib area of the under side are in the four species (*Rh. agastum, Rh. araiophyllum, Rh. hylothreptum, Rh. irroratum*), of which alone we know the young leaves, densely clad with indumentum. Its elements may be hairs with a stout foot and branching freely above, often very long and interwoven, white at first and becoming more or less orange or red, and taking on the greasy appearance so often seen in Rhododendrons (*Rh. agastum, Rh. araiophyllum*). The whole surface may thus be what is known by the generic term tomentose, and this tomentum, composed of flocks of greasy hairs, is a floccose greasy tomentum. Or there may be an admixture of clavate-stalked red glands with similar stout bases (*Rh. hylothreptum*) and the glands may predominate (*Rh. irroratum*). The same covering may spread over the petiole. The under leaf-surface, concealed by the rolling backwards of the sides of the leaf, bears also floccose hairs with stout bases, but they are fewer, not in contact, and the branches are shorter, more prostrate and radiating; there may also be clavate glands and cauliflower glands. (In *Rh. araiophyllum* the under surface appears to be glabrous except on the primary veins and midrib.) Along the margin glands and flocks are also developed. As the leaves unfold the glands and the flocks fall off always above the foot or base, which remains as a red or orange-coloured cone blackening with age, and is the cause of the punctulation of the leaf-surface in the mature leaf. Punctulations on the petiole and on the stems are developed in like manner. In no species, with the exceptions hereafter mentioned, have I seen the juvenile indumentum persisting throughout on the mature leaves and petioles and stems. But if my description has made clear the happenings during the passage from youth to maturity, the persistence of some part of the indumentum in a more or less perfect state is an occurrence that will not cause surprise. In some species this persistence is more marked than in others. *Rh. agastum* retains as a thin

scurfy indumentum layer the floccose hairs on the under surface of the leaf; *Rh. araiophyllum* has often shreds or patches of indumentum adhering to the veins on the under leaf-surface, as has also sometimes *Rh. anthosphaerum*; *Rh. hylothreptum* has often glands on the lower midrib which may be also slightly puberulous. The places where vestiges (apart from the punctulae) remain most constantly are the groove of the upper midrib and of the petiole and the petiole itself. *Rh. irroratum* is one of the species which seems to get rid of most of its early indumentum; yet in plants from the Chungtien plateau quite a stratum of grey withered indumentum may remain on stem and petiole. In *Rh. pogonostylum* this stratum in the few specimens we have remains for a couple of years. There is room here for considerable variation in individual plants, and from what I have said the point of my comment that glabrescent, not glabrous, is the more correct descriptive term to use in speaking of the mature state in these species will be apparent. I must add this. In some species the vestigial cones of the fallen glands or hairs are hard to find even under some considerable magnification on the upper leaf-surface. One can hardly speak of the surface as punctulate. Apparently the vestigial cones are very low and do not colour red or orange, and are thus inconspicuous. I have not sifted this matter. Then the vestigial cones on the leaf margins are more feebly developed in some species than in others. *Rh. irroratum* offers an example of conspicuous development, so much so that the projection of these cones associated with the slight undulation gives an appearance of notching to the leaf margin which is very characteristic. Where the vestiges are smaller the effect they give is that of a roughening of the edge. This juvenile indument character and its graded removal is most typical of the Irroratum series. Although I have been able to trace the development in only four out of the thirteen species, yet the similarity in mature characters of all of them seems to demand the same explanation, and I feel justified in assuming that when the material required for investigation is obtained it will support my prediction of like development.

Two modifications have to be recorded.

Rh. mengtszense differs from its fellows in respect of this indumental character by bearing on its mature leaf-petiole and stems setae and gland-setae as a dense persistent and thick coating. It is quite strigillose. Traces of these setae are to be found upon and about the midrib, both above and below the leaf, particularly towards its base, and very large punctulations occur all over the veins, so that I have no difficulty in correlating this exceptional setose condition as a special development within the typical evolution.

Rh. ceraceum and *Rh. lukiangense* appear more exceptional. The leaf-surfaces here show no conspicuous red punctulation, though there are traces of it, but are covered with a skin of wax so prominent as to give them a smooth aspect on the under side as if varnished. The glossiness is less on the upper side. The stem is also wax-covered, and so is the petiole, and when the stem and petiole shrivel in drying the wax stratum scales off the surface in a series of flakes which are found coating the parts as a white crust. There are no hairs or glands or their vestiges visible on the blades, petioles, and stems of this species. Certain marks on the leaf-margin suggest vestiges of glands or hairs, but not certainly, and we do not know the bud condition of the species. These indumental characters in *Rh. ceraceum* and *Rh. lukiangense* are not fundamentally different from those in the rest of the series. There is only an excess of wax and reduction in other indumental elements. Suspicion, however, of its position as one of the series might be aroused. In all its other features it seems to show its descent in common with those of the Irroratum series. Whilst I think that the feature of indumentum has been too much overlooked by workers amongst Rhododendrons, I do not subscribe to any overrating of its value as a phyletic character. It has not apparently always the same construction in forms belonging to the same phylum, no more than it has in other genera. But differential—and critically so—it is in some cases where the appraisement of other characters has in the past proved faulty for specific determination. I will say this, that two plants in which the construction of the indumentum is different are not the same species, and conversely, two plants which have indumentum of the same construction

may be of different species. In a phylum such as that of Irroratum the indumentum in most of the forms is constructed on the same lines, but that does not keep us from recognising specific segregation amongst the forms based upon other diagnostic characters. At present we are only on the threshold of the study of indumentum in Rhododendron. In the example of this Irroratum series with which I am dealing I see differences in the punctulations of the mature leaves which I have no doubt would add to the sum of differential characters of the species had one only time and eyes to follow out an investigation of them. This will be one of the necessary tasks of a future monographer of Rhododendron. Meanwhile Mr. H. F. Tagg, Assistant in the Museum of the Royal Botanic Garden, Edinburgh, is devoting some time to the study of the forms exhibited by the indumentum in Rhododendron, and has obtained some interesting results. I had hoped, having the advantage of the co-operation of Mr. R. M. Adam, Assistant in the Studio here, whose skill as a photographer is unrivalled, to have been able to provide a series of illustrations from microspecimens of typical forms of indumentum, and many of them have been prepared, but he is now doing more valuable work in serving the guns, and who shall say that our intention will reach fruition.

It may not be amiss to mention here that most of these species of the Irroratum series seem to be infested by a fungus which sends out upon the under leaf-surface in particular small black rod-like conidiophores, upon which conidia are seldom seen, except under shelter of the midrib. These conidiophores look like solitary black setae upon a small black cushion, and must not be confused with real appendages of the Rhododendron itself. Large black spots and tubercles of fungal origin are also abundant sometimes upon the leaves.

Turning now to the inflorescence and flower of the Irroratum series.

The typical form of the inflorescence is a compact globular truss of many flowers arranged on usually short pedicels one centimeter or under long in *Rh. adenostemonum, Rh. ceraceum, Rh. eritimum, Rh. gymnanthum, Rh. lukiangense, Rh. pogonostylum, Rh. spanotrichum*; in the

others not over one and a half centimeters, excepting *Rh. mengtszense* (2 cm.). The truss is racemose-umbellate, with a rhachis varying from one centimeter or even less in *Rh. mengtszense* and *Rh. anthosphaerum* to three centimeters in *Rh. irroratum*; in most of them it is about one and a half centimeters long. The clothing of this rhachis is not the same in all. It is glandular (*Rh. adenostemonum*, *Rh. irroratum*); floccose (*Rh. anthosphaerum*, *Rh. araiophyllum*, *Rh. eritimum*, *Rh. hylothreptum*, *Rh. pogonostylum*); floccose glabrescent (*Rh. gymnanthum*); tomentosely and persistently floccose (*Rh. ceraceum*, *Rh. lukiangense*); scurfy (*Rh. tanastylum*); floccose glandular (*Rh. agastum*); gland-setose (*Rh. mengtszense*); glabrous (*Rh. spanotrichum*). These are the features as they appear in the dried specimens, but owing to lack of material I am not confident that they are truly representative. I see, for example, in *Rh. adenostemonum* traces of a tomentum under the insertion of some of the pedicels, but am unable to determine whether these are vestiges of an early tomentum covering the whole rhachis, are localised axillary tufts to the bracts such as one finds in many species of Rhododendron in which the rhachis is not tomentose, or are portions of the hair-tufts which coat the inside surface of the base of the bracts and which have become adherent to the rhachis or base of the pedicel.

I have seen no perfect flower-buds, but from bracts which have remained during the earlier stages of anthesis, I gather that the outer bracts are more or less rotundate, more or less crustaceous and coriaceous, have the central portion somewhat concave inwardly, with the margin thinner, and are more or less glandular on the outside. The inner fertile bracts seem fairly uniformly oblong, wedge-shaped, somewhat truncate at the top, always densely and whitely sericeous outside, and sometimes also glandular towards the apex. The bracteoles are often longer than the pedicels, and are not glandular. The pedicels, like the inflorescence rhachis, vary in clothing:—glabrous (*Rh. araiophyllum*, *Rh. lukiangense*); puberulous (*Rh. ceraceum*); floccose (*Rh. spanotrichum*, *Rh. tanastylum* or glabrous); floccose glabrescent (*Rh. eritimum*, *Rh. gymnanthum*); glandular (*Rh. agastum*, *Rh. irroratum*); glandular floccose

(*Rh. anthosphaerum, Rh. hylothreptum, Rh. pogonostylum*); gland-setose (*Rh. mengtszense*) and the degrees of persistence of the several indumenta is also somewhat variable.

The series includes Rhododendrons with very small calyx —cup-shaped and fleshy with almost obsolete lobes—and it is glandular (*Rh. agastum, Rh. irroratum*); glandular and floccose (*Rh. anthosphaerum, Rh. pogonostylum*); glandular and puberulous (*Rh. adenostemonum, Rh. hylothreptum*); puberulous (*Rh. ceraceum*); gland-setose (*Rh. mengtszense*); glabrous and flock-fringed (*Rh. araiophyllum, Rh. eritimum, Rh. gymnanthum, Rh. tanastylum*); glabrous (*Rh. lukiangense, Rh. spanotrichum*).

In the matter of the corolla, which is most commonly tubular-campanulate — openly campanulate (*Rh. araiophyllum, Rh. mengtszense*, and perhaps, *Rh. spanotrichum*) and funnel-campanulate (*Rh. adenostemonum* and *Rh. gymnanthum*)—much variation in size is sometimes shown within one species. For instance, in *Rh. irroratum* it may be 4 cm. long or as much as 5·5 cm. The bottom of the tube is always gibbous and retuse. The size of the lobes varies with their number. Five lobes seem to be typical of the Irroratum series, but departures from this number are found in *Rh. anthosphaerum* (5–6), *Rh. agastum* (5–7), *Rh. eritimum* and *Rh. hylothreptum* (7), and in the 5-lobed forms the lobes seem to be larger than in the others. It is evident that a small series of dried specimens is inadequate for the certain determination of petal numbers in forms showing fluctuations such as appear in *Rh. agastum* and *Rh. anthosphaerum*, and counts made in many more specimens are required. Colour character in the corolla divides the series in two. In most of the species it is some shade of red, often dark, in three species (*Rh. adenostemonum, Rh. araiophyllum, Rh. irroratum*) it is white sometimes suffused pink on the outside, in *Rh. irroratum* often pale yellowish or greenish white, in *Rh. pogonostylum* pink. Blotching and spotting are found, but dried material is not always a safe guide in this character. So far as I am able to decide from our material the distribution is:—no blotch and no spots (*Rh. ceraceum*), blotch and spots (*Rh. anthosphaerum, Rh. araiophyllum, Rh. gymnanthum, Rh. hylothreptum, Rh. tana-*

stylum), blotch and no spots (*Rh. agastum*, *Rh. eritimum*, *Rh. mengtszense*, *Rh. spanotrichum*), spots and no blotch (*Rh. adenostemonum*, *Rh. irroratum*, *Rh. lukiangense*, *Rh. pogonostylum*). In *Rh. araiophyllum* a basal posterior large blotch has a beautiful rich dark crimson tint. There are no data through which to correlate some diagnostic characters of clothing of the corolla to which I will now refer, characters which doubtless have a relation to protection in the flower or to attraction in connection with pollination. *Rh. irroratum* is exceptional in having red glands distributed on the outside of the corolla, and they are present also in *Rh. pogonostylum* in addition to basal hairs. These are red clavate glands with short stalks, and are mostly seen upon the midrib of the petaline segments and often conspicuously on the back of the lobes. Occasionally they are absent from one or other of the petaline segments, present in the unfolding, but they seem in some cases to fall off as the corolla expands. These glands offer a readily observed mark of distinction within the series, and are in particular useful for separating *Rh. irroratum* from its nearest ally *Rh. adenostemonum*, which bears glands upon the staminal filaments and not upon the corolla. As a consequence perhaps of this glandular state in these two species, I find their flowers are much more insect-eaten than those in other species. *Rh. pogonostylum* is an exception also, for the corolla outside is puberulous at the base. Then the inside of the corolla tube in the series shows two states. In less than one-half of the species (*Rh. adenostemonum*, *Rh. agastum*, *Rh. anthosphaerum*, *Rh. hylothreptum*, *Rh. irroratum*, *Rh. pogonostylum*) it has a greater or less covering of hairs; in the rest (*Rh. araiophyllum*, *Rh. ceraceum*, *Rh. eritimum*, *Rh. gymnanthum*, *Rh. lukiangense*, *Rh. mengtszense*, *Rh. spanotrichum*, *Rh. tanastylum*) the inside of the tube is glabrous. I suspect there is some correlation between these hairs and the red blotch which is always gland-secreting, but have no observations to record.

Diplostemony gives to most of the species of the Irroratum section 10 stamens. In *Rh. eritimum* and *Rh. hylothreptum*, which have 7 petals, there are 14 stamens. Fluctuations from 10–12 stamens are found in *Rh. agastum* and *Rh. anthosphaerum*. Although 7 petals occur in *Rh. agastum* I have

not found 14 stamens. The stamens are always unequal in length, the longest usually about a centimeter longer than the shortest, but in *Rh. gymnanthum* and *Rh. spanotrichum* the difference is quite 2 cm. The longest stamens in the series are those of the larger flowers in *Rh. irroratum*. They may be 4·5 cm. long, whilst in the shorter flowers of that species they are only 3 cm. *Rh. araiophyllum*, which has the smallest flowers of all the species, has stamens showing smallest dimensions—the longest only 2·8 cm. long. In four of the species the filaments are glabrous (*Rh. eritimum*, *Rh. lukiangense*, *Rh. spanotrichum*, *Rh. tanastylum*). Diels assigns glabrous filaments to *Rh. gymnanthum*, but hairs are present, few perhaps, and only developed a short distance above the base of the filaments—in other species which have hair-appendages to the filaments they start from the very base; there is no naked base to the filaments as in some other series of Rhododrendron. The hairiness of the filaments in these other species may amount to puberulousness only, often in very fine degree (*Rh. anthosphaerum*, *Rh. ceraceum*, *Rh. irroratum*, *Rh. mengtszense*), or may be a true pubescence (*Rh. adenostemonum*, *Rh. agastum*, *Rh. araiophyllum*, *Rh. hylothreptum*), and it is usually confined to the base of the filament up to about the top of the ovary. In *Rh. adenostemonum*, *Rh. hylothreptum*, and *Rh. pogonostylum* it extends much further up the filament to its middle or beyond that, and in *Rh. adenostemonum* we have this unique feature, that mixed with the hairs and above the limit to which they reach are red, shortly-stalked glands—an unusual occurrence.

The character of the disk is not sufficiently taken note of in Rhododendrons. Measurements of the ovary include sometimes I think the disk, and where it is very hairy the character may easily be assigned to the ovary. In the Irroratum series the disk is short and smooth, quite glabrous (*Rh. anthosphaerum*, *Rh. araiophyllum*, *Rh. eritimum*, *Rh. gymnanthum*, *Rh. irroratum*, *Rh. pogonostylum*, *Rh. spanotrichum*, *Rh. tanastylum*); hairy in degrees of pubescence and puberulousness (*Rh. adenostemonum*, *Rh. ceraceum*, *Rh. hylothreptum* (minutely), *Rh. lukiangense*, *Rh. mengtszense*); floccose (*Rh. agastum*).

The gynaeceum is a little longer than the stamens and

always shorter than the corolla. The ovary is narrow, cylindric, or somewhat conoid, black on the surface and usually grooved, varying in length from 5–7 mm. It may be glabrous (*Rh. critimum*, *Rh. gymnanthum*, *Rh. hylothreptum* (sometimes floccose), *Rh. lukiangense*, *Rh. tanastylum*); puberulous (*Rh. araiophyllum*, *Rh. ceraceum*); floccose (*Rh. anthosphaerum*, *Rh. spanotrichum*); glandular (*Rh. agastum*, *Rh. irroratum*); glandular above floccose below (*Rh. adenostemonum*); floccose so densely as to conceal an under glandular layer (*Rh. pogonostylum*); gland-setose (*Rh. mengtszense*). In four species (*Rh. adenostemonum*, *Rh. agastum*, *Rh. irroratum*, *Rh. mengtszense*) the style is glandular throughout, in *Rh. pogonostylum* it is densely floccose as well as glandular throughout; in all the others glabrous. In *Rh. anthosphaerum* the flocks of the ovary sometimes spread on to the base of the style; only a few, however, appear there, and the style is rightly described as glabrous. Usually the style expands slightly, and gradually passes into the lobulate stigma seated on its summit and not wider than the style itself, but in *Rh. agastum* the stigma is relatively massive and forms a broad discoid body somewhat spongy which overhangs the sides of the style.

I have seen fruit and seed only in *Rh. pogonostylum*. The capsule is large and thick, some 4 cm. long by 1 cm. in diameter, and is slightly curved, black, and showing the remains of the ovarian indumentum. A fruiting specimen of another undescribed undoubted member of the series suggests this is not the only type. The seeds are flattened oblong, about 3 mm. by 1 mm., with a wing all round and a white chalazal crest.

The species seem to fall into four small alliances within the series:—

1. *Irroratum* type—plants with rigid, pointed leaves and white or pink flowers—includes:
   Rh. adenostemonum, *Rh. irroratum*, *Rh. pogonostylum*.
2. *Gymnanthum* type — plants with narrow, papery (not in all), pointed leaves and white or red flowers—includes:
   Rh. araiophyllum, *Rh. gymnanthum*, *Rh. mengtszense*, *Rh. spanotrichum*, *Rh. tanastylum*.
3. *Anthosphaerum* type—plants with broad, thick, parchmenty, pointed leaves and red flowers—includes:
   Rh. anthosphaerum, *Rh. ceraceum*, *Rh. hylothreptum*, *Rh. lukiangense*.

4. *Agastum* type—plants with rigid, blunt leaves and red flowers—includes:
Rh. agastum, Rh. eritimum.

Irroratum.

Here the foliage is rigid, thick, and coriaceous, the shape of the leaf lanceolate or oblong lanceolate or ovate lanceolate, sometimes somewhat oblanceolate, with the marginal undulation very distinct and the notching from the fallen glands and flocks conspicuous. The stem and petioles whilst glabrescent retain often the flocks and glands of youth. This little group is markedly glandular, and the punctulations caused by the fallen glands are easily seen. Pedicels, calyx, ovary, style—all have glands sometimes mixed with flocks. The corolla is glandular outside in *Rh. irroratum*, the stamens in *Rh. adenostemonum*; in *Rh. pogonostylum* there are glands outside the corolla, as in *Rh. irroratum*, though fewer, and also a coating of hairs. The flowers are white or yellowish-white, with a flush of rose, or are pink, are in dense many-flowered raceme-umbels, have 5 petaline lobes and 10 stamens. The species cover the area from the north-west of Yunnan to the south-east.

KEY TO THE SPECIES.

Leaves rigid, thick, coriaceous, lanceolate oblanceolate or ovate-lanceolate, base obtuse or rounded, mat on both surfaces, margin conspicuously undulate and notched.
Corolla 5-lobed, glabrous glandular or glandular and puberulous outside, puberulous inside, spotted, not blotched. Stamens 10. Style glandular or floccose and glandular.
Calyx glandular. Style glandular.
Corolla white or cream or suffused rose.
Ovary glandular. Pedicel 1 cm. or more glandular.
Corolla tubular-campanulate glandular outside. Stamens finely puberulous at base, eglandular. Inflorescence rhachis glandular. Petiole glandular and floccose glabrescent . . . . . *irroratum*
Ovary glandular with some flocks. Pedicel under 1 cm. glandular.
Corolla funnel-campanulate glabrous outside. Stamens pubescent to middle and beyond, glandular. Inflorescence rhachis glandular and floccose (?). Petiole glandglabrescent . . . . . *adenostemonum*

Calyx densely floccose and glandular. Style floccose and glandular.
Corolla pink.
Ovary densely floccose and with glands. Pedicel under 1 cm. floccose and glandular.
Corolla tubular-campanulate glandular and puberulous outside, puberulous inside. Stamens pubescent to middle and beyond eglandular. Inflorescence rhachis floccose. Petiole floccose glabrescent . *pogonostylum*

GYMNANTHUM.

These are plants with thin twigs and lanceolate papyraceous leaves, usually narrow (sometimes broad, *Rh. tanastylum*) even cuneate at the base, with marginal undulation fairly distinct but only slightly roughened from fallen flocks. Wax is much developed, making the under surface somewhat glossy, and in *Rh. gymnanthum* the upper surface quite glossy. Stem and petioles may be floccose and glabrescent, gland-glabrescent or gland-setose. This, except for the special development of gland-setae in *Rh. mengtszense*, is a conspicuously eglandular group—glands are absent from pedicels, calyx, ovary, and style. The flowers, white, red, or deep crimson, are in few (about 8-) flowered raceme-umbels with thin rhachis, have 5-lobed corolla, glabrous inside and out, and 10 stamens, puberulous save in *Rh. spanotrichum* and *Rh. tanastylum*. The species are absent from the Tali-Chungtien area, but range from N.W. of Tseku in the Salween basin southwards to E. Upper Burma and the Shweli-Salween divide at Tengyueh in W. Yunnan, and then turn up at Mengtsz in the S.E.

KEY TO THE SPECIES.

Leaves papyraceous (sometimes thicker), lanceolate or oblanceolate, base usually narrow and cuneate, one or both surfaces somewhat glossy, margin inconspicuously undulate and roughened; petiole floccose or gland-glabrescent or persistently gland-setose.
Corolla 5-lobed, glabrous outside and in. Stamens 10. Style glabrous, rarely glandular.
Calyx glabrous flock-fringed. Corolla blotched and spotted. Petiole floccose glabrescent. Style glabrous.
Corolla white. Ovary puberulous. Pedicel 1 cm. or more glabrous.
Corolla openly campanulate. Stamens pubescent. Inflorescence rhachis floccose. Leaf mat above, subglossy beneath . . . . *araiophyllum*

Corolla red. Ovary glabrous. Pedicel 1 cm. floccose glabrescent.
Corolla funnel-campanulate. Stamens puberulous. Inflorescence rhachis glabrescent. Leaf glossy above, subglossy beneath . *gymnanthum*
Corolla tubular-campanulate. Stamens glabrous. Inflorescence rhachis scurfy. Leaf mat above, subglossy beneath . . . . *tanastylum*
Calyx glabrous or sparingly floccose. Corolla blotched not spotted. Petiole gland-glabrescent. Style glabrous.
Corolla red. Ovary sparingly floccose. Pedicel under 1 cm. floccose.
Corolla campanulate. Stamens glabrous. Inflorescence rhachis glabrous. Leaf mat above, subglossy beneath . . . . *spanotrichum*
Calyx gland-setose. Corolla blotched not spotted. Petiole persistently gland-setose. Style glandular.
Corolla red. Ovary gland-setose. Pedicel 2 cm. gland-setose.
Corolla openly campanulate. Stamens puberulous. Inflorescence rhachis gland-setose. Leaf mat above, somewhat glossy beneath . *mengtszense*

Anthosphaerum.

These are plants with chartaceous more or less broadly lanceolate leaves, usually dark coloured above, borne upon fairly stout twigs, and they are always floccose or floccose and glandular in parts. The development of wax in *Rh. ceraceum* and *Rh. lukiangense* tends to exclude other forms of indumentum. The many red flowers on the short stout rhachis of inflorescence form a large compact truss. Whilst 5-lobed corollas and 10 stamens are constant (*Rh. ceraceum, Rh. lukiangense*), we find 5–6 lobes and 10–12 stamens in *Rh. anthosphaerum* and 7 lobes with 14 stamens in *Rh. hylothreptum*. This set is found only from the Likiang range northwards to Tseku and the Chungtien plateau.

KEY TO THE SPECIES.

Leaves chartaceous not rigid, more or less broadly lanceolate or oblanceolate, base obtuse, mat above, sometimes glossy beneath.
Corolla red 5–7-lobed, glabrous outside, glabrous or puberulous inside. Stamens 10–14. Style glabrous. Inflorescence rhachis floccose.
Calyx puberulous fringed. Corolla without blotch or spots.
Ovary puberulous. Pedicel under 1 cm. puberulous.

Corolla tubular-campanulate, 5-lobed, glabrous inside. Stamens 10, finely puberulous at base. Leaf glossy underneath. Petiole white waxy . . . . . *ceraceum*

Calyx glabrous occasionally fringed. Corolla spotted.

Ovary glabrous. Pedicel under 1 cm., glabrous.

Corolla tubular-campanulate, 5-lobed, glabrous inside. Stamens 10, glabrous. Leaf somewhat glossy underneath. Petiole white waxy . *lukiangense*

Calyx glandular and floccose. Corolla blotched and spotted.

Ovary sparingly floccose. Pedicel 1 cm. or more glandular and floccose.

Corolla tubular-campanulate 5–6-lobed, puberulous inside. Stamens 10–12, finely puberulous at base. Leaf mat on both surfaces or somewhat glossy underneath. Petiole floccose and gland-glabrescent . . . . *anthosphaerum*

Calyx glandular and puberulous, rarely gland-fringed. Corolla blotched and spotted.

Ovary glabrous (at times floccose). Pedicel 1 cm. or more sparingly glandular and floccose.

Corolla widely tubular-campanulate 7-lobed, puberulous inside. Stamens 14, pubescent to middle. Leaf mat on both surfaces or somewhat glossy underneath. Petiole glandular and floccose glabrescent . . . . *hylothreptum*

AGASTUM.

The two species included here are alike in foliage-form but differ in many other characters. The leaves are rigid, long, narrow, oblong, and blunt, with an abrupt beak-point, the surface mat on both sides, the under-leaf punctulation very evident. One of them (*Rh. agastum*) tends to eglandular indumentum, the other (*Rh. eritimum*) to be glabrous. The large red flowers form a large compact truss, and the corolla is conspicuously 7-lobed but is sometimes only 5-lobed in *Rh. agastum*, and the stamens which ought to be and are 14 in *Rh. eritimum* are only 10–12 in *Rh. agastum*: I have not found a flower of this with 14 stamens, nor have I seen a 6-lobed corolla. One species is from the Chungtien plateau in the far N.W., the other from the Shweli-Salween divide in the W. As they stand, one can hardly speak of them as allied within the series to which they both certainly belong; they are only alike in shape of leaf. Perhaps uniting links may be found. For purposes of recognition in the series it is convenient to place them together.

KEY TO THE SPECIES.

Leaves oblong blunt with an apicular tip, surfaces mat.
Corolla red, tubular-campanulate, glabrous outside, blotched without spots.
Calyx glandular and gland-fimbriate.
Corolla 5- or 7-lobed, puberulous inside. Stamens 10 or 12. Style glandular.
Ovary glandular. Pedicel 1 cm. or more glandular. Petiole glabrescent.
Stamens 10–12, pubescent. Inflorescence rhachis floccose and glandular. Stigma discoid. Leaf with thin persistent under-leaf indumentum . *agastum*
Calyx glabrous and flock-fimbriate.
Corolla 7-lobed, glabrous inside. Stamens 14. Style glabrous.
Ovary glabrous. Pedicel under 1 cm. floccose glabrescent. Petiole glabrous.
Stamens 14, glabrous. Inflorescence rhachis floccose. Stigma not discoid. Leaf without persistent under-leaf indumentum . . . *eritimum*

This Irroratum series appears to me to be a natural phylum. That the forms of it which I present here represent all its members I do not for one moment suppose.[1]

[1] In the Kew Herbarium are three sheets which the Director of Kew has kindly lent to me with others for examination. Their tickets run :—

1. Yunnan :—Mengtsz. Mountain glens. 6000–7000 ft. Flowers cream-coloured. Rare. Hancock. No. 179. 14th April 1895.
2. Yunnan :—Mengtsz. N. mountains. 8000 ft. Tree 15–20 ft. Henry. No. 10,301. [In fruit.]
3. Hort. Kew, iv, 07. No. 179/98. A. Henry.

The three plants represented are in my view of the same species, and the fact that the plant was in cultivation at Kew gives special interest to the question—What is it? The plant is now dead, the Director of Kew tells me.

Hemsley and Wilson * place Hancock's No. 179 and Henry's 10,301 in *Rh. irroratum*. They are not that species, although they belong to the Irroratum series. The cultivated plant is correctly marked by Mr. Hemsley as "aff. *irroratum*" in the Kew Herbarium. Rehder and Wilson in Plantae Wilsonianae, i (1913), 539 do not refer to these specimens. The plant represented on these sheets awaits description, but I am not to give it here because Hancock's specimen, the only native one with flowers, is not quite adequate, unless it were sacrificed to the analysis. I prefer not to use the cultivated specimen as a basis of description until evidence is forthcoming by which to test the view of identity I have stated. There is no doubt about its right to a place in the Irroratum series. It is one of the minority of the series in its possession of a style glandular throughout, and it has an axis of inflorescence about 1·5 cm. long and puberulous, pedicels glandular with a few floccose hairs, corolla puberulous inside, stamens pubescent at base and eglandular, disk apparently glabrous, ovary glandular and slightly floccose—the flocks being very scarce in the cultivated plant.

* In Kew Bulletin (1910), 112.

Nor will I maintain that the limits assigned to the several species in the descriptions which I have given will not require modification when we come to know more about the plants in their living state and have for comparison with them the additional and new forms which I expect. Looking at the members of the series in the dried state, the differences between them and the characters for demarcation are easily recognised, and I believe my segregation of forms and microforms in the series is sound. As so many of the species are known at present from collection in one locality only, we may be prepared for future discoveries showing perhaps that the fluctuations in such characters as numerical symmetry of the flower and in the indumentum of the ovary, for instance, occur also in others than those in which they have been observed up till now. At the same time let us note that *Rh. irroratum*—the species which we know best, and over an area from Tali to the Chungtien plateau and Tseku—is, save for size variation in the flower, a most constant form.

Rhododendron adenostemonum, Balf. f. et W. W. Sm.[1]

Small tree reaching about 4 m. high with medium thick branches. Branches a year old pale green or dirty grey

[1] *Rhododendron adenostemonum*, Balf. f. et W.W. Sm.—Arbor parva ad 4 m. alta ramis haud crassis. Rami annotini pallide virides vel sordide grisei rubro-glandulosi vel glandularum vestigiis punctulati. Alabastra foliorum ignota. Folia petiolata ad 14 cm. longa; lamina rigide coriacea lanceolata vel oblongo-lanceolata ad 11·5 cm. longa ad 3 cm. lata apicem versus leviter attenuata acutiuscula tuberculo parvo corneo terminata margine cartilaginea obscure undulata et cicatricibus subasperata basi anguste vel late obtusa saepe inaequalis supra primo olivacea vel subglauco-viridis nunc tandem rubido-brunnea opaca laevis haud rugulosa costa media sulcata venis primariis utrinsecus circ. ad 16 vix distinctis glabrescens sed pedibus glandularum detersarum obscure punctulata subtus cinnamomea costa media venisque primariis elevatis substramineis vel suberubescentibus venularum reti rubido immerso ubique pedibus rubris glandularum detersarum punctulata; petiolus circ. 2·5 cm. longus crassus supra sulcatus glabrescens sed cicatricibus glandularum notatus. Flores circ. 12 in racemo-umbellam dispositi rhachi glandulis rubris et pilis sebaceis floccosis (?) plus minusve obtecta; bracteae fertiles oblongo-cuneatae subtruncatae subapiculatae circ. 3 cm. longae circ. 1·4 cm. latae submembranaceae brunneae extus sericeae et apice rubro-glandulosae vertice fimbriatae margine eciliatae intus basi excepta sericeae; bracteolae lineares circ. 1·4 cm. longae circ. 0·5 mm. latae pedicellos superantes spadiceae adpresso-sericeae; pedicelli crassi breves circ. 4 mm. longi dense rubro-glandulosi. Calyx minutus circ. 2·75 mm. longus cupularis cupula extus sparse glandulosa 5-lobatus, lobis carnosulis late triangularibus vel ovatis dorso puberulis et sparsissime glandu-

glandular with red glands or punctulate with gland-vestiges. Foliage buds unknown. Leaves petiolate as much as 14 cm. long; lamina rigid coriaceous thickish lanceolate or oblong-lanceolate as much as 11·5 cm. long by 3 cm. broad slightly attenuated towards the apex and somewhat acute terminated by a small horny tubercle, margin cartilaginous slightly undulate and somewhat roughened by the cicatrices of fallen appendages, base narrowly or broadly obtuse often unequal; upper surface at first olivaceous or sometimes glaucous green frequently becoming reddish-brown mat smooth not rugulose, midrib grooved primary veins about 16 pairs scarcely distinct, whole surface glabrescent but obscurely punctulate with the bases of glands (or hairs ?) which have fallen; under surface cinnamon-coloured with the midrib and primary veins raised somewhat straw-coloured or somewhat reddening, network of the veinlets dark red immersed surface everywhere punctulate with the red bases of glands (or hairs ?) which have fallen; petiole about 2·5 cm. long thick grooved above glabrescent but marked by the cicatrices of glands. Flowers about 12 in a raceme-umbel the axis of inflorescence covered with red glands and perhaps with greasy floccose hairs; fertile bracts oblong wedge-shaped somewhat truncate and apiculate about 3 cm. long by 1·4 cm. broad submembranaceous brownish, outside sericeous and red-glandular at the fimbriate apex, margin

losis glandulis breviter stipitatis margine nunc glanduloso-ciliatis. Corolla alba vel leviter roseo-suffusa infundibuliformi-campanulata circ. 4·5 cm. longa extus eglandulosa epilosa intus copiose puberula postice evariculata maculis paucis notata 5-lobata, lobis ellipticis vel rotundatis nunc emarginatis subcrenulatis circ. 1·8 cm. longis circ. 2·5 cm. latis. Stamina 10 inaequalia longiora circ. 3·5 cm. longa breviora circ. 2·5 cm. antheris purpureis circ. 3·5 mm. longis, filamentis aurantiacis basi paullo expansis ab ima basi ad medium vel ultro saepe fere ad apicem tenuiter pubescentibus et rubro- vel aurantiaco-glandulosis. Discus pilis albis pubescens. Gynaeceum circ. 4·3 cm. longum; ovarium conoideum sulcatum circ. 6 mm. longum fulvo-olivaceum vel nigricans glandulis rubris brevistipitatis ex toto obtectum et pilis sebaceis floccosis rubris (ramulis acutissimis) in dimidio infero nunc fere ex toto praeditum; stylus gracilis ex toto rubro-glandulosus sub stigmate spongioso subdiscoideo leviter ampliatus.

Species *Rh. irrorato*, Franch. affinis, pedicello brevi haud 1 cm. longo, calyce extus puberulo, corolla infundibuliformi-campanulata extus eglandulosa, staminum filamentis ad medium vel ultro tenuiter puberulis et glandulosis, disco pubescente, ovario partim floccoso, stigmate subdiscoideo diversa.

ciliate, inside sericeous except at the base; bracteoles linear about 1·4 cm. long and 0·5 mm. broad longer than the pedicels chestnut-brown adpressed-sericeous; pedicels thick short about 4 mm. long densely red-glandular. Calyx minute about 2·75 mm. long cupular, cup sparingly glandular outside, 5-lobed; lobes fleshy broadly triangular or ovate puberulous on the back and most sparingly glandular with shortly stalked glands, margin occasionally gland-ciliate. Corolla white or slightly suffused with rose funnel-campanulate about 4·5 cm. long outside eglandular and epilose inside copiously puberulous and on the posterior side evariculate but with a few spots, 5-lobed; lobes about 1·8 cm. long by 2·5 cm. broad, elliptic or rounded occasionally emarginate and subcrenulate. Stamens 10 unequal the longer about 3·5 cm. long the shorter about 2·5 cm.; anthers purple about 3·5 mm. long; filaments orange slightly expanded at the base and from the very bottom up to the middle and beyond it (often even to the apex) pubescent and provided with red or orange glands. Disk pubescent with white hairs. Gynaeceum about 4·3 cm. long; ovary conoid grooved about 6 mm. long tawny olive or sometimes blackening covered with red shortly stalked glands throughout and in the lower half provided with greasy floccose red hairs with very sharp-pointed branches, occasionally these extend to near the top: style slender red-glandular throughout slightly expanded under the spongy somewhat discoid stigma.

S.E. Yunnan:—Mengtsz. N. mountains, forests. 7000 ft. Tree 15 ft. Flowers pure white. Henry. No. 11,067. In Herb. Kew.

S.E. Yunnan:—Mengtsz. N. mountains, forests. 8500 ft. Tree 10 ft. Flowers white with a little pink. Henry No. 11,067A. In Herb. Edin.

This is one of the plants of Henry's collecting from the region of Mengtsz, and was referred by Hemsley and Wilson[1] to *Rh. irroratum*. Subsequently Rehder and Wilson[2] suggested that it might, with others of Henry's collecting about Mengtsz, be a variety of *Rh. gymnanthum* (see under *Rh. mengtszense* and *Rh. spanotrichum* in this paper). It certainly finds its place in the Irroratum series

[1] Kew Bulletin (1910), 12. [2] Plantae Wilsonianae, i (1913), 539.

along with *Rh. gymnanthum* and *Rh. irroratum*, and it is a very near ally of *Rh. irroratum* itself. Glandular stems, petioles, pedicels, and styles belong to both species; the points of difference between them are these:—The inflorescence rhachis has apparently (but see p. 164) floccose and adpressed hairs with glands, in *Rh. irroratum* glands only are present; the flower in *Rh. adenostemonum* has pedicels seldom over 1 cm. long; those of *Rh. irroratum* are over 1 cm. long; the calyx in *Rh. adenostemonum* has the cup sparingly glandular and the back of the lobes more or less puberulous, with a few stray glands particularly at the base and now and then one in the margin; in *Rh. irroratum* the calyx-cup is densely glandular and the lobes gland-fringed, there are no hairs; the corolla and stamens show a curious antithesis in character—*Rh. adenostemonum* has a funnel-shaped corolla, glabrous, quite eglandular on the outside and densely pubescent inside, and the staminal filaments are conspicuously puberulous to the middle and beyond it, and show in addition a remarkable development of small, red, shortly-stalked glands, in some cases up to near the base of the anther (hence its specific name); *Rh. irroratum* has a tubular-campanulate corolla which has a development of small, short-stalked, red glands on the outside, particularly along the midribs of the petals, inside it is densely puberulous and the stamens are finely puberulous at the base only, and have no glands; then the disk in *Rh. adenostemonum* is pubescent, in *Rh. irroratum* glabrous, and the ovary, glandular in both, has in *Rh. adenostemonum* floccose hairs as well all over or at the base only. The characters I have mentioned seem to be constant in *Rh. irroratum* in a large series of specimens I have examined from different areas of its wide distribution, from Tali to the Chung-tien plateau. Of *Rh. adenostemonum* I have only seen specimens from one locality, one sheet of them, No. 11,067 in the Kew Herbarium, kindly lent to me by the Director of Kew, and one sheet, No. 11,067A in the Edinburgh Herbarium. The sum of the differential characters, fluctuating though some of them may be in other species, is to me conclusive against conspecificness of the two plants. Of individual characters, that of the gland development on

the filaments—a rare feature—in one, and gland development on corolla in the other, is of weight. Taking further into consideration the fact that Henry's plant (*Rh. adenostemonum*) is a plant of the extreme south-east of Yunnan, in the basin of the Red River, somewhere about latitude 23° 25′ N., and dwells at an altitude of 8500 feet, whilst *Rh. irroratum* is a Middle-West and East-North-West Yunnan plant essentially of the Yangtze basin, at its lowest latitude—25° 40′ N., on the Tali range—living at an altitude of 11,000–12,000 feet at its highest latitude, 27° 30′ N., on the Chungtien plateau, at 9000–10,000 feet, I do not hesitate about regarding them as distinct species.

With *Rh. gymnanthum* our species has much less in common. *Rh. gymnanthum* is a red-flowered species with very narrow leaves, glossy above, with eglandular floccose stems, petioles, inflorescence rhachis, pedicels, and a glabrous style, glabrous fringed calyx, the fringe lobes sometimes gland-tipped, corolla glabrous inside and out, staminal filaments eglandular and most sparingly puberulous near base, disk glabrous, ovary glabrous.

Rhododendron agastum, Balf. f. et W. W. Sm.[1]

Shrub as much as 6 m. high with thick branches. Young branches of the year more or less clad with clavate

[1] *Rhododendron agastum*, Balf. f. et W. W. Sm.—Frutex ad 6 m. altus ramis crassis. Ramuli hornotini glandulis clavatis plus minusve vestiti annotini pallide virides glabrescentes pilorum juvenilium vestigiis plus minusve notati. Alabastrorum perulae intimae membranaceae flavido-brunneae ligulato-spathulatae circ. 2·5 cm. longae circ. 4 mm. latae viscidae extus glandulis clavatis plus minusve indutae intusque pilis floccosis sebaceis vestitae ad apicem acuminatum pilo-cristatae; folia juvenilia revoluta supra pilis floccosis multiramosis tomentosa subtus pilis plurimis brevissime stipitatis copiose radiatim ramulosis ramulis patentibus laxe reticulatim intertextis induta; petiolus juvenilis tomentosus. Folia petiolata ad 14 cm. longa; lamina coriacea crassa stricte oblonga nunc supra medium paullo latior circ. ad 12 cm. longa ad 4 cm. lata haud attenuata apice obtusa corneo-mucronata margine subplana cartilaginea obscure undulata et pilorum juvenilium pedibus vel pilis ipsis paucis praedita basi late obtusa supra opaca olivacea laevis costa media sulcata venis primariis utrinsecus ad 15 occultis glabrescens nunc pilorum juvenilium vestigiis obscure notata subtus fulvo-olivacea minutissime rufo-punctulata costa media straminea elevata plus minusve glandularum pilorumque vestigiis praedita venis primariis venularumque reti prominulo cum superficie ubique indumento tenui subfurfuraceo e pilis multo-brachiatis (ramulis ab umbone sessili rubro radiatim patentibus) composito vestitis; petiolus ad 2 cm. longus crassus glabrescens supra sulcatus pilorum vestigiis plus minusve praeditus. Flores ad 20 racemoso-

glands; branches a year old, pale green glabrescent marked more or less by the vestiges of juvenile hairs (or glands?). Innermost scale-leaves of the foliage-buds membranaceous yellow-brown ligulate spathulate about 2·5 cm. long by 4 mm. broad viscid clad outside more or less with clavate glands, inside with floccose greasy hairs and a hair crest at the acuminate apex; juvenile leaves revolute upper surface tomentose with much-branched floccose hairs, under surface clad with very many shortly-stalked hairs abundantly and radiatingly branched, the branches spreading out laterally and becoming loosely interwoven; juvenile petiole tomentose. Leaves petiolate as much as 14 cm. long; lamina coriaceous somewhat thick truly oblong, occasionally slightly wider above the middle, about 12 cm. long by 4 cm. broad not attenuated at the apex but obtuse terminated by a horny mucro, margin somewhat flat cartilaginous obscurely undulate and showing the bases of juvenile hairs or even a few hairs themselves, base broadly obtuse; upper surface mat olivaceous smooth with a grooved midrib primary veins about 15 pairs hidden the whole surface glabrescent but occasionally obscurely marked by the vestiges of juvenile hairs; under surface tawny olivaceous most minutely red-punctulate, midrib

umbellati rhachi ad 2 cm. longa glandulis et pilis sebaceis induta; bracteae fertiles circ. 3 cm. longae circ. 1·3 cm. latae submembranaceae oblongo-obovatae vel obovato-spathulatae apiculatae intus extusque albido-sericeae glandulis paucis intermixtis; bracteolae lineares ramentaceae adpresso-pilosae circ. 1 cm. longae; pedicelli circ. 1·2 cm. longi fusco-brunnei dense clavato-glandulosi. Calyx parvus circ. 3 mm. longus cupularis extus dense glandulosus, lobis 7 distinctis rotundatis vel ovatis vel deltoideis glandulosis et glanduloso-fimbriatis. Corolla rosea postice emaculata sed varo basali magno kermesino praedita tubuloso-campanulata magna circ. 5 cm. longa gynaeceum et stamina superans extus glabra eglandulosa intus copiose puberula, lobis 5–7 rotundatis emarginatis subcrenulatis circ. ad 2 cm. longis ad 2·4 cm. latis. Stamina 10–12 inaequalia longiora circ. 3·8 cm. longa breviora circ. 2·7 cm. longa antheris brunneis circ. 4 mm. longis, filamentis deorsum latioribus a basi ad apicem ovarii pubescentibus. Discus sebaceo-floccosus. Gynaeceum circ. 4·5 cm. longum; ovarium cylindrico-conoideum sulcatum circ. 6 mm. longum circ. 3·5 mm. diam. nigrescens clavato-glandulosum ad basim nunc pilis sebaceis paucis indutum; stylus crassus ex toto glandulosus; stigma magnum latum discoideum lobulatum.

Species ex affinitate *Rh. anthosphaeri*, Diels sed foliis oblongis ad extremitates haud attenuatis, subtus indumento indutis, corolla emaculata 5–7-lobata, staminum filamentis ad basim pubescentibus haud brevissime puberulis, disco floccoso, ovario clavato-glanduloso, stylo glanduloso, stigmate lato discoideo facile distinguenda.

straw-coloured and more or less raised provided with vestiges of glands and hairs, primary veins and the reticulation of the veinlets somewhat prominent, the whole surface clad with a thin somewhat scurfy stratum of indumentum consisting of many-armed hairs with red branches radiating and spreading from a sessile umbo: petiole thick as much as 2 cm. long glabrescent grooved above and showing more or less vestiges of hairs. Flowers in a racemose umbel about 20-flowered the axis of inflorescence about 2 cm. long and covered with glands and greasy hairs: fertile bracts about 3 cm. long by 1·3 cm. broad submembranaceous oblong-obovate or obovate-spathulate apiculate whitely sericeous both outside and inside with a few glands intermixed; bracteoles linear chaffy adpressed-pilose about 1 cm. long; pedicels about 1·2 cm. long reddish-brown and densely clavate-glandular. Calyx small about 3 mm. long cupular, outside densely glandular 7-lobed; lobes rounded or ovate or deltoid glandular and gland-fimbriate. Corolla rose-coloured emaculate on the back but with a large basal crimson blotch tubular-campanulate large about 5 cm. long exceeding the stamens and gynaeceum, outside glabrous eglandular, inside copiously puberulous; lobes 5-7 rounded emarginate somewhat crenulate about 2 cm. long by 2·4 cm. broad. Stamens 10–12 unequal longer about 3·8 cm. long, shorter about 2·7 cm. long; anthers brown about 4 mm. long; filaments widening downwards and from their base to the apex of the ovary pubescent. Disk greasily floccose. Gynaeceum about 4·5 cm. long; ovary cylindric-conoid grooved about 6 mm. long by 3·5 mm. in diameter blackening clavate-glandular occasionally coated at the base with a few greasy hairs; style thick glandular throughout; stigma large broad discoid lobulate.

W. Yunnan:—Head of the Taipungpu valley. Alt. 7000–8000 ft. Lat. 25° 30′ N. In oak and pine forest. Shrub of 10–15 ft. Flowers rose. G. Forrest. No. 9920. May 1913.

W. Yunnan:—Descent to the Yangpi valley. Alt. 9000 ft. Lat. 25° 40′ N. Margins of forests. Shrub of 30 ft. Flowers deep rose, without markings. G. Forrest. No. 12,389. April 1914.

This striking species is one of two (the other *Rh. eritimum*) within the Irroratum series in which the leaves are truly oblong with a somewhat beaked apex. It is also the only species in the series in which the juvenile indumentum of the under side of the leaf persists, forming here a thin veil over the reticulate venulose surface. Another conspicuous character in which it is alone in the Irroratum series is its large discoid stigma. The numerical symmetry of the flower seems to be variable. In the specimen No. 9920 the corolla is 5-lobed and there are 10 stamens. In No. 12,389 the corolla is 7-lobed and there are 12 stamens. The majority of species in the series are 5-lobed in the corolla and diplostemonous; two species (*Rh. eritimum* and *Rh. hylothreptum*) have 7-lobed corollas and are diplostemonous. *Rh. anthosphaerum* has a 5–6-lobed corolla and 10–12 stamens. The numbers counted in *Rh. agastum* seem to suggest that one may expect a 5-, 6- or 7-lobed corolla and 10–14 stamens. The settlement of this question, which involves the diagnostic value of numerical symmetry in the series, will, I hope, be achieved by Mr. Forrest during the further exploration of Yunnan, which he is undertaking.

Rhododendron anthosphaerum, Diels in Notes R.B.G. Edin., v (1912), 215.[1]

Shrub or small tree as much as 9 meters high. Branches stout, those a year old blackish-grey densely clad with

[1] The description by Diels runs :—

Rhododendron anthosphaerum, Diels. Frutex vel arbor 6–9 m. alta. Folia petiolo glabro 1·5 cm. longo praedita ; papyracea, supra glabra, subtus rufescenti-pallidiora, oblanceolata, acuta, 8–13 cm. longa, 2·5–5·2 cm. lata, nervi subtus inconspicui. Flores 10–15 dense congesti, pedunculi 7–12 mm. longi, pubescentes. Calycis minuti lobi inconspicui triangulares, glandulosi, vix 1 mm. longi. Corolla intense rosea atro-purpureo-maculata, campanulata ; tubus 2·5–3·5 cm. longus 3·2–4 cm. latus ; lobi rotundati 1·5–2 cm. diamet. Stamina 10 basim versus minute puberula, 3–3·5 cm. longa. Ovarium glabrescens, 5–8 mm. longum ; stylus 3–3·5 cm. longus, praeter basim puberulam glaber.

"Shrub or tree of 20–30 ft. Flowers bright rose-magenta, with a few markings of black-crimson. Open situations in pine forests on the ascent to the Sungkwei pass from the Langkiung valley. Lat. 26° 30′ N. Alt. 10,000–11,000 ft. April 1906." G. Forrest. No. 2042.

Habit of *R. irroratum*, Franch. but easily recognised by the colour of the flowers and the more glabrous ovary and the absence of glands on the style.

rufous clavate glands mixed with flocci of greasy hairs; older branches with vestiges of these. Foliage buds and young leaves unknown. Leaves petiolate as much as 14 cm. long; lamina papyraceous broadly lanceolate rarely (if small) somewhat oblanceolate as much as 12 cm. long and 5 cm. broad always narrowed to both ends, apex acute with a horny blunt mucro, margin cartilaginous flat obscurely undulate and roughened (hardly notched) by the persistent bases of juvenile greasy hairs, occasionally some hairs persist, base obtuse: upper surface opaque bronze-green midrib and primary veins (about 18 pairs) slightly sulcate elsewhere the irregular network of the ultimate veins shows clearly in the dried leaf (I expect invisible in the fresh) whole surface apparently glabrous but slight vestiges of juvenile hairs are present; under surface mat fawn-coloured midrib prominent straw-coloured (as are the primary veins only less prominently so) more or less sprinkled with withered and withering floccose hairs and also with orange-coloured bases of fallen flocks and glands, such bases are abundant over the rest of the surface but do not show up markedly as distinct punctulations, the epidermal cells form low dome-shaped papillæ, the fawn colour of the whole under surface is due to the coloration of the reticulate venation: petiole as much as 2 cm. long stout grooved above, marked by scars of fallen glands and hairs which may sporadically persist. Flowers about 12 in a terminal racemose-umbel with very short red brown floccose rhachis not 1 cm. long; bracts unknown; bracteoles about 1 mm. long very narrowly linear reddish sericeo-pilose; pedicels as much as 1·3 cm. long pale brown fairly densely coated with a mixture of floccose and simple sebaceous hairs and a few clavate glands. Calyx minute cupular fleshy clavate-glandular floccosely and greasily pilose outside, about 1·5 mm. long; lobes more or less deltoid. Corolla tubular-campanulate 5–6-lobed, bright rose-magenta with a posterior basal black-crimson blotch and a few like-coloured spots about 4·5 cm. long exceeding androecium and gynaeceum, glabrous outside puberulous inside; lobes about 2 cm. long and 2·5 cm. broad rounded emarginate somewhat crenulate. Stamens 10–12 unequal, longest some 3·3 cm. long shortest 2·3 cm.; anthers about 3 mm. long purple;

filaments widened at base and from there finely puberulous to above ovary. Disk most glabrous. Gynaeceum about 4 cm. long shorter than corolla; ovary about 6 mm. long conoid furrowed blackening sparingly coated with flocks of greasy hairs or single greasy hairs or with cauliflower glands; style glabrous throughout slightly clavately expanding into lobulate non-discoid stigma.

Mr. Forrest obtained this in only one locality, that of the Sungkwei pass (East-North-West Yunnan), a station in which *Rh. irroratum*, Franch.—with which it has affinity, as Diels points out,—also occurs. *Rh. anthosphaerum* cannot be mistaken for *Rh. irroratum*." It wants the glaucous foliage of that species and has bright red flowers. The mature leaves are papery in texture, not rigid, thick, coriaceous as in *Rh. irroratum*; they are longer and broader, and the midrib below has more or fewer greasy hairs persisting upon it. The inflorescence rhachis is shorter and is floccosely pubescent not glandular as in *Rh. irroratum*, and the same indumental difference appears in the pedicels. There are never glands on the outside of the corolla. Then we have the interesting fact in *Rh. anthosphaerum* that the corolla lobes vary from 5 to 6, and there is a corresponding fluctuation in the stamens from 10 to 12. I have not found a 7-lobed corolla nor 14 stamens. *Rh. irroratum* seems to be a form with a strictly 5-lobed corolla. No fluctuation in size of corolla and flower parts generally appears in *Rh. anthosphaerum*. The filaments here are finely puberulous from the very base upwards to just above the ovary, as in *Rh. irroratum*. The gynaeceum offers distinctive characters. The blackening ovary has the glands of *Rh. irroratum* replaced by greasy floccose or single hairs, and instead of being glandular the style of *Rh. anthosphaerum* is glabrous throughout, the stigma not discoid. Diels refers to a puberulous base of the style. This only refers to the fact that there is occasionally a slight extension of the flocks of the ovary upon the lowermost part of the style, but one cannot rightly speak of the style as being puberulous at base (see also p. 168).

More near is the relationship with *Rh. hylothreptum*, Balf. f. et W. W. Sm., also from the Sungkwei pass.

Rhododendron araiophyllum, Balf. f. et W. W. Sm.[1]

Slender branched shrub as much as 5 m. high. Branches a year old reddening more or less white floccose glabrescent and glossy, after some years (4–5) grey and decorticating. Outermost scale-leaves of the foliage-leaf buds—which are

[1] *Rhododendron araiophyllum*, Balf. f. et W. W. Sm. — Frutex tenuiramosus ad 5 m. altus. Ramuli annotini erubescentes plus minusve albido-floccosi glabrescentes et nitidi post annos 4–5 grisei decorticantes. Alabastrorum anguste ovoideorum acutorum circ. 4 mm. diam. perulae extimae crustaceo-coriaceae fulvae circ. 8 mm. longae infra rotundatae circ. 3 mm. longae et latae supra in caudam circ. 5 mm. prolongatae extus eglandulosae plus minusve sebaceo-floccosae, intermediae longiores et latiores ecaudatae mucronatae subovatae, intimae convolutae membranaceae flavido-brunneae ad 2·7 cm. longae circ. 4 mm. latae acutae saepe mucronulatae dorso apiceque margineque sebaceo-floccosae intus glabrae ad apicem sericeae ; folia juvenilia revoluta supra et costa media subtus pilis floccosis longi- et multi-ramosis saepe sebaceis rufo-coloratis intricatim intertextis densissime tomentosa superficie inferiore glaberrima : petiolus juvenilis sebaceo-tomentosus. Folia petiolata ad 12·5 cm. longa ; lamina chartacea lanceolata ad 11·5 cm. longa ad 3 cm. lata apice subacuminata tuberculo corneo terminata margine subplana obscure undulato-crenulata pilorum juvenilium detersilium vestigiis notata basi cuneata supra brunneo-olivacea opaca costa media sulcata venis primariis utrinsecus circ. 15 inconspicuis laevis glabra sed floccorum juvenilium vestigiis nunc notata, subtus pallidior saepe fulva subnitens costa media erubescente et venis primariis elevatis glabrescentibus punctulatis vel floccorum juvenilium vestigiis praeditis vel pilis sebaceis dense floccoso-tomentosis caeteroquin glabra epunctulata venularum reti paullo conspicuo epidermide epapillata ; petiolus circ. 1 cm. longus rubidus subcrassus subglabrescens floccorum vestigiis notatus. Flores circ. 8 (nunc pauciores) racemoso-umbellati rhachi tenui ad 1·5 cm. longa pilis floccosis intertextis plus minusve vestita ; bracteae deciduae ignotae ; bracteolae rufescentes angustissime ligulatae ad 1·2 cm. longae sericeo-pilosae ; pedicelli graciles rubro-brunnei glaberrimi nunc pilis floccosis paucissimis praediti circ. 1·5 cm. longi. Calyx minutus cupularis carnosulus circ. 1·5 mm. longus cupula glaberrima 5-lobatus, lobis semi-lunatis vel ovato-truncatis extus glaberrimis margine pilis albidis vel rubris sebaceis simplicibus vel floccosis ciliatis. Corolla alba extus roseo-suffusa brevis aperte campanulata circ. 3·5 cm. longa genitalia superans 5-gibbosa retusa extus eglandulosa epilosa intus glabra et postice varo magno basali kermesino supraque maculis paucis notata 5-lobata, lobis circ. 1·4 cm. longis circ. 2 cm. latis rotundatis emarginatis subcrenulatis. Stamina 10 inaequalia longiora circ. 2·8 cm. longa breviora circ. 1·4 cm. longa antheris rubris circ. 3·5 mm. longis, filamentis basi paullo latioribus et ab ima basi ad apicem ovarii dense pubescentibus. Discus glaber. Gynaeceum circ. 2·8 cm. longum stamina longiora subaequans ; ovarium intense brunneum vel nigrescens papillatum conoideum sulcatum circ. 5·5 mm. longum brevissime albido-puberulum pilis subadpressis ; stylus ruber glaber in stigma purpureum lobulatum paullo ampliatus.

Species *Rh. tanastylo*, Balf. f. et Ward q.v. proxima : *Rh. gymnantho*. Diels etiam affinis foliis brevioribus supra haud nitentibus nunc subtus tomento persistente indutis, floribus minoribus, pedicello glabro, corolla alba roseo-suffusa aperte campanulata, staminum filamentis dense pubescentibus, ovario minore puberulo distinguenda.

narrowly ovoid acute and about 4 mm. in diameter—crustaceo-coriaceous tawny about 8 mm. long, the lower part rounded sheathing about 3 mm. long and broad prolonged upwards into a tail of about 5 mm. long, outside eglandular more or less greasily floccose, intermediate scale-leaves longer and broader without tails but mucronate somewhat ovate, innermost scale-leaves convolute membranaceous yellow-brown as much as 2·7 cm. long and 4 mm. broad acute often mucronulate, greasily floccose on the back at the apex and on the margin, glabrous inside except at the sericeous apex; juvenile leaves revolute the upper surface and the midrib of the lower surface very densely tomentose with long many-branched floccose hairs which are often greasy rufously coloured and are intricately interwoven, rest of the lower surface very glabrous; juvenile petiole greasily tomentose. Leaves petiolate as much as 12·5 cm. long; lamina papery lanceolate as much as 11·5 cm. long and 3 cm. broad somewhat acuminate at the apex where is a terminal horny tubercle, margin somewhat flat obscurely undulate crenulate and marked by the vestiges of juvenile fallen hairs, base cuneate; upper surface brown-olive coloured mat the midrib grooved the primary veins as many as 15 pairs inconspicuous, the whole surface smooth and glabrous but marked occasionally by the vestiges of juvenile flocks; under surface paler often tawny somewhat glossy, midrib reddening and with the primary veins elevated glabrescent punctulate or marked by the vestiges of fallen flocks or somewhat densely floccose tomentose with greasy hairs, the whole surface elsewhere glabrous epunctulate, the reticulation of the veinlets slightly conspicuous, the epidermis epapillate; petiole about 1 cm. long red somewhat thick somewhat glabrescent marked by vestiges of juvenile flocks. Flowers as many as eight (even fewer) in a racemose-umbel with a slender axis as much as 1·5 cm. long and more or less clad with floccose intertwined hairs; bracts deciduous unknown; bracteoles rufescent very narrowly ligulate as much as 1·2 cm. long and silkily pilose; pedicels about 1·5 cm. long, slender reddish-brown very glabrous but occasionally provided with a few floccose hairs. Calyx minute cupular fleshy about 1·5 mm. long, cup very glabrous, 5-lobed; lobes semi-

lunate or ovate truncate outside very glabrous margin ciliate with white or red hairs sometimes simple sometimes floccose. Corolla white suffused outside with rose, short openly campanulate about 3·5 cm. long exceeding the stamens and gynaeceum, 5-gibbous at the base and retuse, outside eglandular and without hairs, inside glabrous and marked on the back by a large basal crimson blotch with a few spots above it, 5-lobed; lobes about 1·4 cm. long and 2 cm. broad rounded emarginate and subcrenulate. Stamens 10 unequal, the longer about 2·8 cm. long the shorter about 1·4 cm. long; anthers red about 3·5 mm. long; filaments slightly wider towards the base and from the very base to the apex of the ovary densely pubescent. Disk glabrous. Gynaeceum about 2·8 cm. long nearly equalling the longer stamens; ovary intensely brown or blackening papillate conoid grooved about 5·5 mm. long, clad with very short somewhat adpressed white hairs; style red glabrous slightly expanding into the purple lobulate stigma.

W. Yunnan. Shweli-Salween divide. Alt. 9000–10,000 ft. In mixed forests and thickets. Shrub of 9–16 ft. Flowers white flushed exterior rose-lavender. G. Forrest. No. 11,918. June 1913.

This is, I think, one of the most charming species of the Irroratum series. Its flowers are described as white flushed rose-lavender on the outside. It is one of the three white-flowered species of the Irroratum series, the others being *Rh. adenostemonum* and *Rh. irroratum*—which are, however, very different plants, particularly in the development of glands. Our species has delicate graceful branches with narrow willow-like leaves, and the flower-trusses if not large are composed of flowers with delicate pedicels and beautifully shaped open campanulate corolla. It may perhaps be regarded as not far removed from *Rh. gymnanthum* in the series, but has smaller leaves which are not polished on upper surface, smaller flowers, a campanulate not funnel-shaped corolla, glabrous pedicels, pubescent not sparingly puberulous filaments to the stamens and a puberulous ovary. Its nearest ally is without doubt an equally pretty species, *Rh. tanastylum*, Balf. f. et Ward, from over the frontier in E. Upper Burma. This may be spoken of as a crimson-flowered *Rh. araiophyllum*, for in

vegetation, habit, and inflorescence the two plants are much alike; but in the Burmese plants the pedicels are shorter, the corolla tubular-campanulate and larger, the staminal filaments are glabrous, as is the ovary, whilst the style is ever so much longer than the stamens.

Not infrequently the leaf under-side retains its juvenile indumentum on the midrib as a floccose tomentum.

Rhododendron ceraceum, Balf. f. et W. W. Sm.[1]

Shrub with medium thick branches. Branchlets a year old as much as 4 mm. in diameter pale green covered

[1] *Rhododendron ceraceum*, Balf. f. et W. W. Sm.—Frutex ramis haud crassis. Ramuli annotini ad 4 mm. diam. pallide virides strati superficialis albi ceracei desquamantis vestigiis plus minusve notati. Alabastra et folia juvenilia ignota. Folia petiolata ad 13 cm. longa; lamina chartacea late lanceolata vel ovali-lanceolata vel sub-oblonga a medio utrinque attenuata nunc oblanceolata ad 11·5 cm. longa ad 4 cm. lata apice abrupte acuta subrostrata corneo-tuberculata margine plana vel paullo recurvata cartilaginea obscure undulata (et pilorum juvenilium pedibus minutissimis notata) basi obtusa supra olivacea subnitens glaberrima fere epunctulata costa media erubescente sulcata venis primariis utrinsecus circ. 16 vix conspicuis caeteroquin laevis vel obscure reticulata (lamina in vicinitate venarum primarum nunc erubescente) subtus fulvo-viridis glaberrima costa media venisque primariis erubescentibus elevatis venularum reti rubido vel fulvo nitens laevis cerivernicosa epidermide epapillata; petiolus crassus corrugatus circ. 1·5 cm. longus supra sulcatus cerae strato albo desquamante notatus. Flores inflorescentiae cujusque circ. 10 racemoso-umbellati rhachi circ. 1·5 cm. longa pilis albis floccosis adpressis dense tomentosa; bracteae fertiles oblongae vel obovato-spathulatae ad 2·8 cm. longae ad 1 cm. latae membranaceae flavido-brunneae ciliatae extus dense sericeae intus prope apicem centro sericeae; bracteolae delicatissimae filiformes adpresso-pilosae circ. 1 cm. longae; pedicelli vix 1 cm. longi brunnei sparsim et minute puberuli. Calyx cupularis minutus circ. 1·5 mm. longus extus sparsim puberulus, lobis nunc deltoideis nunc late semi-lunatis nunc rotundatis minutissime fimbriatis. Corolla rosea(?) tubuloso-campanulata circ. 3·7 cm. longa androecium et gynaeceum superans extus intusque glabra emaculata evariculata, lobis 5 subaequalibus circ. 1·5 cm. longis circ. 2 cm. latis rotundatis emarginatis vel retusis plus minusve crenulatis. Stamina 10 inaequalia longiora circ. 3·3 cm. longa breviora circ. 2 cm. longa antheris atro-purpureis circ. 3·25 mm. longis in staminibus longioribus circ. 2 mm. in brevioribus, filamentis complanatis basi vix latioribus ibique minutissime puberulis eglandulosis. Discus pubescens. Gynaeceum circ. 3·5 cm. longum stamina paullo superans corolla brevior; ovarium atro-purpureum leviter sulcatum angustum cylindricum circ. 6 mm. longum 2 mm. diam. sparsim puberulum (saepe solum infra medium) rarissime hic et illic glandula singula praeditum; stylus glaber sub stigmate lobulato paullo clavatim expansus.

Species *Rh. anthosphaero*, Diels affinis sed eglandulosa et foliis cerivernicosis, ramulis petiolisque ceraceo-desquamantibus, inflorescentiae rhachi dense sericeo-floccoso-tomentosa, pedicello brevi haud 1 cm. longo puberulo, calyce puberulo fimbriato, corolla minore intus glabra, disco

with a surface stratum of white desquamating wax or its vestiges. Foliage-leaf buds and juvenile leaves unknown. Leaves petiolate as much as 13 cm. long; lamina chartaceous broadly lanceolate or somewhat oblong or oval-lanceolate, occasionally oblanceolate as much as 11·5 cm. long and 4 cm. broad apex abruptly acute somewhat beaked ending in a horny tubercle, margin flat or slightly recurved cartilaginous obscurely undulate and minutely marked by the bases of fallen juvenile hairs, base obtuse; upper surface olivaceous somewhat glossy almost epunctulate very glabrous, the often reddening midrib grooved, primary veins about 16 pairs hardly conspicuous, elsewhere smooth or obscurely reticulate (in older leaves a tendency to reddening of surface about the primary veins); under surface tawny green very glabrous with the often reddening midrib and primary veins elevated the network of the ultimate veins red or tawny, the whole surface glossy smooth wax-varnished almost epunctulate with an epapillate epidermis; petiole thick wrinkled about 1·5 cm. long grooved above clad with a desquamating white stratum of wax. Flowers of the inflorescence about 10, racemosely umbellate the axis of inflorescence about 1·5 cm. long densely tomentose with white floccose adpressed hairs; fertile bracts oblong or obovate-spathulate as much as 2·8 cm. long and 1 cm. broad membranaceous yellow-brown ciliate, outside densely silky, inside near apex in the middle silky; bracteoles most delicately filiform adpressed-pilose about 1 cm. long; pedicels scarcely 1 cm. long brown sparsely and minutely puberulous. Calyx cupular minute about 1·5 mm. long outside sparsely puberulous; lobes deltoid sometimes broadly semi-lunate sometimes rounded most minutely fimbriate. Corolla rose-coloured (?) tubular-campanulate about 3·7 cm. long exceeding the stamens and gynaeceum outside and inside glabrous without blotch or spots, 5-lobed; lobes nearly equal about 1·5 cm. long and 2 cm. broad rounded emarginate or retuse more or less crenulate. Stamens 10 unequal, longer about 3·3 cm. long shorter about 2 cm. long: anthers dark purple

pubescente, ovario puberulo valde diversa; a *Rh. lukiangensi*, Franch. foliis brevioribus et latioribus apice haud rostratis laete nitentibus, pedicellis cum calyce staminumque filamentis ovarioque puberulis, corollae minoris lobis subaequalibus postice maculatis recedens.

about 3·25 mm. long in longer stamens about 2 mm. in shorter; filaments flattened at the base scarcely widened and there most minutely puberulous eglandular. Disk pubescent. Gynaeceum about 3·5 cm. long slightly exceeding the stamens but not the corolla; ovary black-purple slightly grooved narrow cylindric about 6 mm. long by 2 mm. in diameter and most sparingly puberulous (often below the middle only) very rarely bearing here and there a single gland; style glabrous slightly shorter than corolla and slightly clavately expanded under the lobulate stigma.

W.N.W. Yunnan. Tseku. Monbeig. No. 166. Herb. Edin. 1907.

A remarkable species, which we know only in specimens collected by Père Monbeig, and of which the precise locality is not recorded. The specimens were received at Edinburgh in 1907 when Père Monbeig was residing at Tseku, and Mr. Forrest, to whose kind intervention we are indebted for them, tells me that Père Monbeig's collections at that time were made mainly to the N.W. of Tseku, and this plant may therefore come from across the Tibeto-Yunnan frontier. I hope Mr. Forrest may find during his next exploration and send home material to enable us to study more fully the structure and development of the protective coating of shoot and leaf. This covering is interesting. In the dried specimens the one-year-old stem and the petioles are more or less white with irregular flakes of wax which have cracked off the surface as shrivelling has proceeded. The older stems and petioles gradually lose all trace of these flakes. The lamina on the under side is glossy and covered with a uniform wax-stratum. Apparently this peels off in places and by so doing bares the coloured reticulation of the veinlets that in other places from which it has not separated is less conspicuous. The upper surface is much less glossy, and to what degree it is wax-coated I am unable to say on the evidence I have. The whole feature requires for complete understanding living material for dissection. In *Rh. lukiangense*, which is the nearest ally to *Rh. ceraceum* and very like it in many ways, there is the same coating of wax, but in our specimens the coating seems to remain longer

on the surface, yet the effect somehow is of a less shining surface. Otherwise *Rh. lukiangense* can be diagnosed from *Rh. ceraceum* by the unequal corolla-lobes, the spotted corolla, the glabrous pedicels, calyx, stamens, and ovary.

The very glossy surface of the under-leaf in *Rh. ceraceum* distinguishes it at sight from other species which it resembles in many ways and with which it is allied. The distinctive association of marks of *Rh. ceraceum* in the series is—the wax-coating, no glands, floccose-tomentose rhachis of inflorescence, puberulous pedicels and calyx, 5-lobed corolla glabrous outside and inside, puberulous ovary.

Rhododendron eritimum, Balf. f. et W. W. Sm.[1]

Shrub reaching about 6 m. in height with thick glabrous branches. Foliage-leaf buds unknown. Leaves shortly

[1] *Rhododendron eritimum*, Balf. f. et W. W. Sm.—Frutex ad 6 m. altus ramis crassis glabris. Alabastra et folia juvenilia ignota. Folia breviter petiolata ad 18 cm. longa; lamina subrigida subcrasse coriacea anguste oblonga ad 17 cm. longa ad 4·5 cm. lata apice obtusa subrostrata mucronata margine subrevoluta cartilaginea obscure undulata haud asperata basi anguste cuneata utrinque glaberrima supra olivacea costa media sulcata leviter erubescente venis primariis utrinsecus ad 18 paullo sulcatis caeteroquin minutissime papillata subtus glauca costa media elevata venis primariis erubescentibus et venularum reti immersis caeteroquin laevis obscure aurantiaco-punctulata papillis globosis epidermicis minute induta; petiolus vix 1 cm. longus crassus glaber. Flores circ. 15 in inflorescentiam racemoso-umbellatam dispositi rhachi circ. 1·2 cm. longa sparsim (sed in axillis bractearum dense) kermesino-floccosa; bracteae fertiles membranaceae spadiceo-brunneae circ. 2·5 cm. longae circ. 9 mm. latae extus dense albido- et rufo-sericeae intus superne plus minusve adpresso-pubescentes; bracteolae anguste ligulatae 1 cm. longae fere 1 mm. latae pedicellos superantes dense pilosae; pedicelli circ. 8 mm. longi subcrassi floccis paucis conspersi glabrescentes. Calyx minutus circ. 2 mm. longus cupularis glaberrimus, lobis ovatis vel rotundatis vel deltoideis margine subfimbriatis. Corolla lurido-rosea late tubuloso-campanulata ad 4 cm. longa extus intusque glabra varo notata sed emaculata 7-lobata, lobis rotundatis haud magnis circ. 1·3 cm. longis circ. 1·6 cm. latis emarginatis subcrenulatis. Stamina 14 inaequalia longiora circ. 3·3 cm. longa breviora circ. 2 cm. antheris atro-purpureis circ. 3 mm. longis, filamentis vix deorsum latioribus glaberrimis. Discus glaberrimus. Gynaeceum circ. 3·5 cm. longum corolla paullo brevius stamina paullo superans; ovarium cylindricum angustum paullo sulcatum atro-purpureum glaberrimum circ. 5 mm. longum; stylus glaber gracilis in stigma lobulatum haud discoideum paullo ampliatus.

Species *Rh. anthosphaero*, Diels affinis sed foliis anguste oblongis, petiolo glabro, pedicellis brevioribus haud 1 cm. longis eglandulosis, calyce glaberrimo, corolla 7-lobata intus glabra, staminum 14 filamentis glabris, ovario glaberrimo recognoscenda; in forma foliorum *Rh. agasto*, Balf. f. et W. W. Sm. similis sed illa species pedicellos et calyces et ovaria et stylos glandulosos, pedicellos 1 cm. longos, corollae tubum intus puber-

petiolate as much as 18 cm. long; lamina somewhat rigid and thick coriaceous narrowly oblong as much as 17 cm. long 4·5 cm. broad, apex obtuse somewhat rostrate mucronate, margin somewhat revolute cartilaginous obscurely undulate not roughened, base narrow cuneate; both surfaces very glabrous and mat; upper surface olivaceous with a grooved midrib slightly reddening, the primary veins about 18 pairs slightly grooved, the rest of the surface most minutely papillate; under surface glaucous, the midrib raised, the primary veins reddening and like the ultimate reticulation of the veinlets not prominent, the rest of the surface smooth obscurely orange-punctulate, the epidermis marked by minute globose papillae; petiole scarcely 1 cm. long thick glabrous. Flowers about 15 in a racemose-umbel with an axis about 1·2 cm. long sparingly but in the axils of the bracts densely rufously floccose; fertile bracts membranaceous chestnut-brown about 2·5 cm. long and 9 mm. broad, outside densely sericeous with white and rufous hairs, inside in the upper part more or less adpressedly pubescent; bracteoles narrowly ligulate about 1 cm. long and almost 1 mm. broad exceeding the pedicel densely pilose; pedicel about 8 mm. long somewhat thick sprinkled with floccose hairs and glabrescent. Calyx minute about 2 mm. long cupular very glabrous, lobes ovate or rounded or deltoid with a subfimbriate margin. Corolla dark crimson widely tubular-campanulate as much as 4 cm. long, outside and inside glabrous, marked by a blotch but without any spots, 7-lobed; lobes rounded not large about 1·3 cm. long by 1·6 mm. broad emarginate subcrenulate. Stamens 14 unequal, longer about 3·3 cm. long, shorter about 2 cm. long; anthers dark purple about 3 mm. long; filaments scarcely widening to the base and quite glabrous. Disk quite glabrous. Gynaeceum about 3·5 cm. long slightly exceeding the stamens and shorter than corolla; ovary cylindric narrow slightly grooved dark purple quite glabrous about 5 mm. long; style glabrous slender slightly expanding into a lobulate not discoid stigma.

ulum, staminum 10–12 filamenta basi pubescentia, discum floccosum, stigma discoideum possedit; *Rh. hylothreptum*, Balf. f. et W. W. Sm. foliis lanceolatis, petiolis glandulosis, pedicellis ultra 1 cm. longis glandulosis, calyce puberulo, corolla intus staminumque filamentis puberulis, disco puberulo distinguitur.

E.N.W. Yunnan:—Mountains of the Chungtien plateau. Alt. 9000 ft. In open thickets. Shrub of 20 ft. Flowers deep plum-crimson, in bud black-crimson. G. Forrest. No. 12,416. March 1914.

A very fine species. By its oblong leaves this species, which belongs to the Irroratum series, is easily picked out amongst its allies. *Rh. agastum* is the only other one of the series with like leaf-form. The character which impresses one particularly in this species is its glabrousness—calyx, corolla, stamens, ovary, and style all are glabrous, and as these are either glandular or puberulous in *Rh. agastum* the differentiation of the two is easily made. The punctulations on the leaves are not very conspicuous. *Rh. eritimum* is a plant of the Chungtien plateau and is only known from there. *Rh. irroratum* extends into the plateau in a remarkably robust form, and these two species have the most northerly distribution of the Irroratum series. Like *Rh. irroratum*, our species has somewhat glaucous foliage, but the leaf-form of *Rh. eritimum* is very different from the pointed lanceolate or oblanceolate type in *Rh. irroratum*, and then its large truss of red flowers with 7-lobed corolla and 14 stamens amongst other characters distinguish it.

Rhododendron gymnanthum, Diels in Notes R.B.G. Edin., v (1912), 211.[1]

Shrub with slender branches. Branches a year old about 3 mm. in diameter glabrescent and shining but still showing

[1] The following is the description given by Diels:—

Rh. gymnanthum, Diels.—Frutex 0·9–2 m. altus. Folia persistentia; superiorum petiolus ca. 1 cm. longus, lamina papyracea, glabra, oblanceolata, basim versus sensim angustata, apice acuta, 10–12 cm. longa, 2·5–3 cm. lata. Racemus brevis terminalis, pedunculi glabri, sepala brevia ca. 1 mm. longa, corolla infundibuliformi-campanulata, rosea, basi purpurea, superius purpureo-punctata vel striolata, 3·5–4 cm. longa, ore 2·5–3 cm. lata; limbi lobi rotundati, 1·5–2 cm. diamet. Stamina 10, filamenta basi paulo latiora, glabra, 2–3 cm. longa. Ovarium 0·5–0·6 cm. longum, conicum, glabrum, stylus ca. 3 cm. longus.

W.N.W. Yunnan:—Mekong-Salween divide, N.W. of Tseku. Alt. 13,000 ft. Lat. 28° 12′ N. Open rocky situations. Shrub of 3–6 ft. Flowers rose with crimson markings.

Similar to *Rh. lukiangense*, Franch. (Tseku, Soulié, No. 1000) but differing by shorter and narrower leaves, larger flowers, and the pedicels not being tomentose. [What Diels refers to here is the axis of inflorescence, not the pedicels.]

more or less tufts and vestiges of floccose greasy hairs with which we must assume the stem is at first clad. No foliage buds or younger twigs have been seen. Leaves petiolate as much as 19 cm. long; lamina coriaceous lanceolate or oblanceolate slightly oblique as much as 17 cm. long and 3·5 cm. broad somewhat shortly acuminate, midrib at the tip swollen into a small horny tubercle, margin cartilaginous obscurely undulate and marked by the scars of fallen relatively broad-based hairs, base cuneate or obtuse; upper surface glaucous-green glossy, wax surface-coating sometimes becoming mat, midrib sulcate slightly reddening and lined more or less by withered remains of floccose greasy hairs, primary veins about 18 pairs slightly visible and sometimes vestigially floccose elsewhere the surface glabrous faintly punctulate by orange-coloured bases of fallen hairs; under surface olive-buff-coloured also somewhat glossy, the midrib raised pinkish and glabrous, the primary veins also slightly raised, the ultimate reticulation showing slightly raised in the dried leaf tending to become purple glabrous and showing minute punctulations from the red or orange bases of fallen hairs; petiole as much as 2 cm. long, not very thick slightly erubescent and glabrescent but more or less clad with withered whitish-grey or reddish remains of floccose greasy hairs and marked by the bases of fallen ones. Inflorescence racemose-umbellate about 8 flowers in the truss, the rhachis slender about 2 cm. long glabrescent but with a few remains of floccose greasy hairs and persistent groups of them in axils of outer sterile bracts; bracts and bracteoles unknown; pedicels stout oblique at top, dark brown floccose glabrescent about 1 cm. long. Calyx small about 2·5 mm. long cupular, cup glabrous with 5 somewhat triangular thinnish lobes which are fringed and erose the divisions often gland-tipped. Corolla rose-coloured with a basal posterior blotch and crimson-spotted above funnel-campanulate about 4 cm. long, exceeding in length androecium and gynaeceum, glabrous both outside and inside, 5-lobed, the lobes rounded retuse and somewhat crenulate about 2 cm. long and broad. Stamens 10 unequal, longer ones about 3·4 cm. long, shorter ones about 1·4 cm. long; anthers dark purple about 2·75 mm.

long; filaments hardly widened at base and above the base provided with a few short hairs they are not glabrous. Disk glabrous. Gynaeceum about 4 cm. long exceeding stamens; ovary cylindric about 7 mm. long very narrow about 1·75 mm. in diameter grooved shining brown-black sometimes papillate, glabrous; style glabrous hardly expanding beneath the lobulate small stigma.

W.N.W. Yunnan:—N.W. of Tseku. Mekong-Salween divide. Alt. 13,000 ft. Lat. 28° 12′ N. Open rocky situations. Shrub of 3–6 ft. Flowers rose with crimson markings. G. Forrest. No. 5071. Aug. 1904.

W.N.W. Yunnan:—Tseku. Monbeig. No. 4. Herb. Kew.

In Herb. Kew there is a good sheet of this under "No. 4 Monbeig," collected at Tseku. Our material at Edinburgh from Forrest, though scanty,—only a twig with five leaves and four flowers—is that upon which Diels founded his species. Through the kindness of the Director of Kew I have had for examination Monbeig's specimen No. 4, and I am able to say that Forrest's specimen is part of the same collecting. In Forrest's early collections are specimens of several different species from Tseku which were of the same collecting as Père Monbeig's, and this is one of them. Hemsley and Wilson[1] referred Monbeig's No. 4 to *Rh. irroratum*, Franch. Later, Rehder and Wilson[2] correctly placed it in *Rh. gymnanthum*. Like most of the Irroratum series this species appears at sight to be quite glabrous, but the evidence of an early floccose condition of axes and leaf are present and the vestiges vary in the degree of their prominence. Except for the glands which tip some of the fringe lobes of the calyx, I have not seen glands upon this plant in its mature state. I have described the disk as glabrous, but in one flower I saw traces of a few very fine short hairs.

I may add a word about the leaf surfaces. The upper is typically glossy from its layer of wax. It is easy to dissolve this in benzol and to remove it, leaving an opaque mat surface. In some of the dried leaves the upper surface is mat—pale and glaucous or olive-green. This seems to be due to a loosening of the wax layer. The under surface

[1] In Kew Bulletin (1910), 113.
[2] Plantae Wilsonianae, i (1913), 539.

is also but less prominently wax-coated. These wax-coatings in the series require further investigation. As I have pointed out on a preceding page, they are developed in varying degree in several species, being particularly evident in *Rh. ceraceum* where the under surface is particularly glossy the upper surface less so, and in all the immediate allies of *Rh. gymnanthum* the under surface has a somewhat shining look from the presence of wax.

Along with *Rh. araiophyllum*, *Rh. mengtszense*, *Rh. spanotrichum*, and *Rh. tanastylum*, the species belongs to that set within the Irroratum series which shows narrow lanceolate or oblanceolate leaves and 5-lobed corolla, glabrous inside and out. *Rh. araiophyllum* is a white-flowered plant with open campanulate corolla and puberulous ovary. *Rh. mengtszense* is a gland-setose plant and readily differentiated by the character. *Rh. spanotrichum* has shorter leaves not glossy above, much more definitely oblanceolate, and its corolla is not funnel-campanulate and its staminal filaments are glabrous. *Rh. tanastylum* has also much shorter leaves but glossy above, and the corolla is tubular-campanulate, the stamens glabrous. Diels mentions and Rehder and Wilson also refer to a likeness of *Rh. gymnanthum* to *Rh. lukiangense*, but the species are very different (see under *Rh. lukiangense*, p. 203).

Rhododendron hylothreptum, Balf. f. et W. W. Sm.[1]

Tree about 9 m. high with thickish branches. Young branches about 3 mm. in diameter densely floccose with

[1] *Rhododendron hylothreptum*, Balf. f. et W. W. Sm.—Arbor ad 9 m. alta ramis subcrassis. Ramuli hornotini circ. 3 mm. diam. dense floccosi (pilorum ramis brevibus) et clavato-glandulosi glandulis rufis vel aurantiacis, seniores earum vestigiis vestiti. Alabastrorum elongato-ovoideorum subviscidorum perulae exteriores late ovatae vel subrotundatae crustaceo-coriaceae brunneae circ. 6 mm. longae ecarinatae haud mucronulatae extus plus minusve rufo-glandulosae intus pilis sebaceis indutae obscure ciliatae, interiores membranaceae spathulatae circ. 3 cm. longae circ. 7 mm. latae spadiceo-brunneae extus puberulae glandulisque vestitae intus plus minusve puberulae apicem versus sericeae vertice acutatae sebaceo-ciliatae; folia juvenilia revoluta supra pilis floccosis longe ramosis et glandulis clavatis paucis dense induta subtus glandulis clavatis et pilis paucioribus breviter ramosis vestita, margine pilis pede lato praedita; petiolus juvenilis dense clavato-glandulosus et pilis floccosis obtectus. Folia petiolata ad 13 cm. longa; lamina chartacea lanceolata nunc oblanceolata ad extremitates attenuata ad 11·5 cm. longa ad 3·5 cm. lata apice acuta corneo-tuberculata margine plana cartilaginea obscure

branched short hairs and also clavately glandular with red or orange glands: older branches marked with the remains of these. Scale-leaves on the outside of the elongated ovoid somewhat viscid buds broadly ovate or somewhat rounded crustaceously coriaceous brown about 6 mm. long without a dorsal keel and not mucronate, more or less rufously glandular on the back, on the inner surface lined by greasy hairs, obscurely ciliate; inner scale-leaves membranaceous spathulate about 3 cm. long 7 mm. broad chestnut-brown puberulous on the back and clad with glands, more or less puberulous within and towards the apex sericeous, the acutish summit being ciliate with greasy hairs; juvenile leaves revolute upper surface densely clad with many-branched floccose hairs and a few clavate glands, under side covered with clavate glands and a smaller number of shortly branched hairs, margin girt by broad-

undulata et pedibus pilorum juvenilium delapsorum minute subasperata basi obtuse vel plus minusve late cuneata supra olivacea opaca costa media sulcata sulco glandulis paucis rubris et pilis ramosis marcidis notato venis primariis utrinsecus circ. 14 paullo sulcatis caeteroquin plana glaberrima floccorum juvenilium vestigiorum inopia notata subtus fulva nunc subnitens costa media elevata leviter erubescente minute puberula et glandulis rubris paucis vel earum vestigiis conspersa venis primariis etiam elevatis caeteroquin subpuberula et glandularum juvenilium pedibus minute punctulata epidermide globoso-papillata; petiolus ad 1·5 cm. longus crassus supra sulcatus glandulis pilisque et earum vestigiis plus minusve obtectus saepe glabrescens. Flores circ. 12 in inflorescentiam racemoso-umbellatam dispositi rhachi ad 1·7 cm. longa pilis floccosis multo ramosis sebaceis rubris plus minusve dense vestita; bracteae deciduae fertiles obovato-oblongae membranaceae extus dense sericeae et glandulosae intus sericeae; bracteolae lineares circ. 9 mm. longae rufae adpresso-pilosae; pedicelli ad 1·5 cm. longi validi glandulis clavatis et pilis sebaceis rufis floccosis conspersi. Calyx cupularis cupula dense glandulosa circ. 2 mm. longus carnosulus, lobis deltoideis vel triangularibus extus plus minusve puberulis margine eglandulosis rarissime glandulis paucis notatis. Corolla late tubuloso-campanulata circ. 4·5 cm. longa genitalia superans basi 7-gibbosa retusa extus glabra intus puberula postice variculata et maculata 7-lobata, lobis circ. 1·7 cm. longis circ. 2 cm. latis rotundatis emarginatis subcrenulatis. Stamina 14 inaequalia longiora circ. 3 cm. longa breviora circ. 2 cm. longa, antheris atro-purpureis circ. 2·5 mm. longis, filamentis roseis a basi ima saepe ad medium copiose pubescentibus. Discus minutissime puberulus. Gynaeceum circ. 3·5 cm. longum; ovarium 6 mm. longum conoideum nigrescens sulcatum glabrum sed rarissime glandulis singulis paucissimis nunc floccis sebaceis plus minusve conspersum; stylus glaber stamina superans in stigma lobulatum haud discoideum paullo clavatim ampliatus.

Species *Rh. anthosphaero*, Diels similis sed calycis cupula glandulosa lobis que puberulis, corolla 7-lobata, staminibus 14, filamentis ad medium copiose pubescentibus, disco minutissime puberulo, ovario glabro bene distincta.

based hairs; juvenile petiole densely clavate-glandular and floccose. Leaves petiolate as much as 13 cm. long; lamina chartaceous lanceolate occasionally oblanceolate narrowed at the extremities as much as 11·5 cm. long 3·5 cm. broad, acute at the apex and crowned by a horny tubercle, margin flat cartilaginous obscurely undulate and minutely roughened by the bases of fallen juvenile hairs, obtuse or more or less broad cuneate at the base; upper surface olivaceous mat with a grooved midrib the groove containing a few red glands and the withered remains of branched hairs, primary veins about 14 pairs slightly grooved, otherwise the surface is flat very glabrous wanting apparently conspicuous vestiges of juvenile flocks; under surface tawny sometimes somewhat glossy midrib elevated erubescent minutely puberulous and sprinked with scattered red glands or their vestiges, primary veins also raised, elsewhere the surface is somewhat puberulous and minutely punctulate, epidermis globosely papillate; petiole as much as 1·5 cm. long thick grooved above and covered with glands and hairs or their vestiges often glabrescent. Flowers about 12 arranged in a racemose-umbel with a rhachis 1·7 cm. long, the axis more or less densely covered with floccose much-branched greasy red hairs; bracts deciduous fertile ones obovate-oblong or oblong membranous, outside densely sericeous and glandular, inside sericeous; bracteoles linear about 9 mm. long rufous with adpressed hairs; pedicels about 1·5 cm. long stout sprinkled with clavate glands and greasy rufous floccose hairs. Calyx cupular, cup about 2 mm. long densely glandular fleshy with deltoid or triangular; lobes more or less puberulous outside, margin eglandular rarely with one or two glands. Corolla broadly tubular-campanulate about 4·5 cm. long exceeding the androecium and gynaeceum, 7-gibbous and retuse at the base, glabrous outside puberulous inside with a blotch and spots on the back, 7-lobed; lobes about 1·7 cm. long and 2 cm. broad rounded emarginate subcrenulate. Stamens 14 unequal, the longer about 3 cm. long, shorter 2 cm.; anthers dark purple 2·5 mm. long; filaments rose-coloured abundantly pubescent from the very base often to the middle. Disk most minutely puberulous. Gynaeceum about 3·5 cm. long; ovary 6 mm. long conoid blackening

grooved glabrous very rarely with a few solitary single glands occasionally sprinkled with floccose greasy hairs: style glabrous longer than the stamens slightly expanding into a slightly clavate apex under the lobulate not discoid stigma.

E.N.W. Yunnan:—Summit of the Sungkwei pass. Alt. 11,000–12,000 ft. Open situations. Shrub of 10–15 ft. Flowers deep magenta-rose with darker markings. G. Forrest. No. 5845. May 1910; in rhododendron forests. Tree of 20–30 ft. G. Forrest. No. 5848. May 1910.

A species which recalls *Rh. anthosphaerum*, Diels, and it comes from the same area—the Sungkwei Pass—but it is quite distinct.

Like *Rh. anthosphaerum* it has broadly lanceolate leaves darkly olivaceous on the upper surface, punctulate below, and there the midrib sometimes shows a few glands. The petioles are usually shorter than in *Rh. anthosphaerum*. Here the corolla is 7-lobed and the stamens correlatively 14. This has not been seen in *Rh. anthosphaerum*, where 5–6 petaline lobes and 10–12 stamens in the flower are met with. Whether or no this is a critical difference future observation must determine. It is in the material we possess definitely diagnostic. Other characters distinguishing *Rh. hylothreptum* from *Rh. anthosphaerum* are the puberulous calycine lobes, the filaments of the stamens copiously puberulous to the middle or beyond not merely finely puberulous at the base, the typically glabrous ovary.

The species is in cultivation under No. 5848, and we have at Edinburgh several plantlets. All of these do not show the characters we expect in *Rh. hylothreptum*, but they are too young as yet to offer sound evidence in reply to the question—What are they? The dried specimens show the plant as most floriferous, and, coming as it does from a high altitude in the north-west of Yunnan, we may expect it to be thoroughly hardy. The flower colour does not, however, appear to be of depth and intensity sufficient to give it a prominent claim for favour in gardens in competition with species of the Sanguineum series or the Thomsoni series.

In addition to the Nos. 5845 and 5848 cited above, we have another plant from Forrest, with the label:—

"E.N.W. Yunnan:—Near the summit of the Sungkwei

pass. Alt. 10,000 ft. Lat. 26° 12′ N. In rhododendron forest. Tree of 20–30 ft. Flowers crimson-rose with deep crimson markings. G. Forrest. No. 5852. May 1910."

This is our species, but it shows the ovary clad more or less with solitary or floccose hairs. In this there is an approach to *Rh. anthosphaerum.*

Rhododendron irroratum, Franch. in Bull. Soc. Bot. France, xxxiv (1887), 280;[1] Hemsl. in Journ. Linn. Soc., xxvi (1889), 26; Bot. Mag. (1894), t. 7361.

Shrub reaching as much as 9 meters in height. New shoots of the year about 3 mm. in diameter rufo-tomentose densely clad with shortly-stalked clavate rufous glands which soon fall; branches a year old tawny and with blackened gland-vestiges, ultimately a dirty grey and decorticating. Foliage buds sticky oblong covered outside with dark-brown crustaceo-coriaceous scale-leaves semi-lunate or rotundate cucullate without a keel slightly ciliate at tip with greasy short hairs, glabrous inside, glandular and puberulous on back; intermediate scale-leaves oblong obovate; inner ones membranous as much as 3·8 cm. long yellowish ligulate-spathulate acute, outside and inside clad with clavate rufous shortly-stalked glands with at the tip a group of floccose greasy hairs; young leaves revolute in ptyxis, upper surface densely covered with an indumentum of floccose hairs having a broad foot and long or short thick stalk giving off more or less greasy branches, margin fringed with like flocks and with stalked clavate

[1] Franchet's description runs :—

Rhododendron irroratum, Franch.—Frutex circiter 6-pedalis, ramis et ramulis glabris; folia usque 5 poll. longa, nunc minora, breviter (7–10 mill.) petiolata, e basi attenuata lanceolata, apice acuta, mucronata, glauca, rigida, glaberrima, nervis secundariis usque 12–15 subtus prominulis; flores ad anthesin glomerati, mox laxi, albi, intus punctis fuscis confertis irrorati, pedunculis 10-12 mill. longis glandulis tenuibus adspersis; calyx inter minimos, extus dense glandulosus, lobis obsoletis rotundatis; corolla extus glabra, intus in parte inferiore puberula, haud magna (vix ultra pollicaris), aperte campanulata, lobis 5 rotundatis; stamina 10, inclusa, filamentis inferne brevissime ciliatis; ovarium glandulis minutis fuscis dense obtectum; stylus gracilis stamina superans, ad apicem usque glandulosus.

Yunnan, in silvis ad Pee-tsao-lo, supra Mo-so-yn, prope Lankong, alt. 2500 m., fl. 9 April (Delav. n. 2352).

Très jolie espèce, remarquable par sa teinte glauque et par ses fleurs blanches abondamment mouchetées de brun.

red glands which may be numerous; under surface more sparingly beset with shorter cauliflower glands or solitary greasy hairs; petiole densely glandular. Leaves petiolate as much as 14·5 cm. long usually less; lamina rigid thick coriaceous usually narrowed to both ends lanceolate or oblanceolate as much as 12·5 cm. long and 3 cm. broad, somewhat acute at the tip with a horny tubercle, margin broadly cartilaginous slightly revolute the edge roughened or notched owing to projecting reddish feet of fallen juvenile hairs, base obtuse or slightly rounded; upper surface pale glaucous green, midrib deeply grooved, primary veins about 16 pairs pinnately spreading at a wide angle slightly grooved, whole surface glabrescent with vestiges of the juvenile hairs; under surface paler usually fawn-colour, midrib and primary veins elevated straw-coloured, whole surface minutely punctulate by red bases of fallen juvenile cauliflower glands or greasy hairs; petiole as much as 2 cm. long usually less, grooved above, thick somewhat fleshy slightly reddened, more or less glandular or marked by vestiges of fallen stalked rufous glands or hairs. Inflorescence shortly racemose umbellate many flowered (over 15), rhachis up to 3 cm. long (often shorter) rufously glandular; bracts outer sterile tawny rounded sometimes apiculate, margin ciliate, clad like outer perulae of foliage buds, inner fertile oblong-spathulate subtruncate submembranaceous about 3·5 cm. long 1 cm. broad, densely sericeous, outside with single white hairs towards apex mixed with glands and floccose greasy hairs, inside glabrous except at apex where is a tuft of white crumpled hairs; bracteoles filiform slightly wider at insertion silkily pilose about 1·8 cm. long or shorter, longer than pedicel; pedicel pale yellow-green about 1·3 cm. long stout glandular with clavate crimson glands. Calyx minute about 2 mm. long cupular densely glandular outside with 5-rounded semi-lunate or ovate or broadly triangular lobes, gland-fringed always epilose. Corolla white or pale yellow or greenish-white with more or fewer crimson spots (there may be many on all the petals) sometimes only a few on the posterior petal and without a blotch posteriorly somewhat fleshy variable in size from 3 to 5·5 cm. long, always longer than stamens and gynaeceum, tubular-

campanulate, 5-lobed, at base 5-gibbous and retuse, outside more or less glandular with short-stalked clavate crimson glands specially on mid-veins of the lobes, inside densely puberulous; lobes rounded emarginate slightly crenulate, in smaller flowers 1·7 cm. long by 2·2 cm. broad, in larger flowers 2 cm. long by 3 cm. broad. Stamens 10 unequal, in smaller flowers longer ones 3 cm. long, shorter 2·3 cm. long, in larger flowers longer 4·5 cm. long, shorter 3·5 cm. long; anthers about 3·5 mm. long dark brown; filaments eglandular slightly wider at base and there finely puberulous from the very base to about top of ovary. Disk most glabrous. Gynaeceum in smaller flowers about 3·3 cm. long, in larger 4·5 cm.; ovary blackening conoid grooved about 5 mm. long and 2·5 mm. in diam. densely clavate-glandular sometimes with a few solitary hairs or flocks of greasy hairs at very base; style red-glandular throughout not expanding below the lobulate stigma but forming a narrow ring.

Specimens I have seen are:—

E.N.W. Yunnan:—In woods at Peetsaolo above Mosoyn, near Langkiung. Alt. 2500 m. In flower, 9th April. Delavay No. 2352.

E.N.W. Yunnan:—Ascent of the Sungkwei pass from the Langkiung valley. Alt. 9000–10,000 ft. Lat. 26° 30′ N. Shady pine and rhododendron forest. Erect shrub of 10–15 ft. Corolla yellowish-white, with a few markings of a greenish-yellow, thick and fleshy. G. Forrest. No. 2043. April 1906.

E.N.W. Yunnan:—Near the summit of the Sungkwei pass ascending from the Langkiung valley. Alt. 11,000 ft. Lat. 26° 30′ N. Open situations. Spreading shrub of 10–15 ft. Corolla greenish-white, profusely marked small dark crimson spots. G. Forrest. No. 2058. April 1906.

Mid. W. Yunnan:—Eastern flank of the Tali Range. Alt. 11,000–12,000 ft. Lat. 25° 40′ N. Open rocky situations. Shrub of 8–12 ft. Flowers white with a few crimson markings. G. Forrest. No. 4146. July 1906.

E.N.W. Yunnan:—Summit of the Sungkwei pass. Alt. 11,000–12,000 ft. Lat. 26° 12′ N. In rhododendron forest. Shrub or tree of 15–30 ft. Flowers pale yellow with crimson markings. G. Forrest. No. 5851. May 1910.

E.N.W. Yunnan:— Langkiung-Hoking divide. Alt. 10,000–11,000 ft. Lat. 26° 25′ N. In rhododendron thickets. Shrub of 10–30 ft. Flowers pale yellow, spotted crimson. G. Forrest. No. 10,023. May 1913.

E.N.W. Yunnan:—Langkiung-Hoking divide. Alt. 9000–10,500 ft. Lat. 26° 25′ N. In rhododendron thickets. Shrub of 20 ft. Flowers white, with a few rose markings flushed rose exterior. G. Forrest. No. 10,032. May 1913.

E.N.W. Yunnan:—Mountains of the Chungtien plateau. Alt. 9000–10,000 ft. Lat. 27° 30′ N. In open thickets. Shrub of 20 ft. Flowers yellowish, white margined rose with deep crimson markings. G. Forrest. No. 12,410. April 1914.

The above record shows that the species has a comparatively large area of distribution in Yunnan. Beginning in the south on the eastern flank of the Tali Range it occurs near Langkiung, the earliest known locality, and apparently is common about that region having been found on the Langkiung-Hoking divide, and in the Sungkwei pass leading out of the Langkiung valley; much farther north it appears on the Chungtien plateau. It is a wonderfully constant type over its area. Some degree of variation it exhibits. In size of leaf, for instance; also in size of flower—and this is the most noteworthy. In Delavay's Langkiung specimen the corolla is, as Franchet says, not large—it does not reach 3·7 cm.—but in some of Forrest's specimens from the Langkiung-Hoking divide (No. 10,032 in particular) the corolla is at least 5·5 cm. long and all the other flower-parts have correlative size-modification. Franchet says nothing of a character of some import diagnostically—the presence of crimson glands on the outside of the corolla. These occur on Delavay's plant (No. 2352), which, through the kindness of M. Lecomte of the Paris Herbarium, I have been enabled to examine. In Forrest's specimens they are prominent, particularly on the mid-veins of the petals, but sometimes a vein may show none.

The species is one of the most easily recognised of all rhododendrons. The rigid more or less lanceolate glaucous apparently quite glabrous leaves are characteristic; their somewhat fawn-coloured under-leaf surface is always

minutely punctulate and the cartilaginous undulate margin is more or less notched and conspicuously punctulate. The upper surface, which in the young leaf is much more densely coated with hairs than is the under surface,—this the consequence of a revolute ptyxis—does not show conspicuously such coloured bases of its fallen hairs, but vestiges of these hairs may be seen, specially about the midrib. The more or less glandular petiole is a character of mark. In the flower region the following characters are important:—the glandular axis of inflorescence, the glandular pedicels, the 5-lobed corolla glandular outside puberulous inside, the filaments of stamens very finely puberulous from base to top of ovary, the rufously glandular ovary without hairs though occasionally at base of and on the ovary a few greasy coloured hairs may occur, the style glandular right to the top and there ending in a stigma which is hardly broader than lower part of style.

Rh. irroratum was brought into cultivation through the Jardin des Plantes of Paris, where it was raised from seeds sent by Delavay. It flowered for the first time in Britain at Kew in 1893, and is figured in the Botanical Magazine (1894), t. 7361. It has flowered elsewhere since then, and seems to be variable in flower colour. Sir Joseph Hooker wrote of it as "in its present condition the least ornamental species of the genus known to me," expressing the hope that when older its merits would be higher. We have it growing at Edinburgh under Forrest's No. 5851, which, through the dried specimens, does not promise to be much better than Delavay's plant. The form from the Chungtien plateau under Forrest's No. 12,410 is evidently much finer.

Rhododendron lukiangense, Franch. in Journ. de Bot., xii (1898), 257.[1]

Shrub with medium thick branches. Branchlets a year old as much as 5 mm. in diameter, pale green covered with

[1] Franchet's description runs:—

Rh. lukiangense, Franch.—Folia petiolata, coriacea, utraque facie glaberrima, multicostata, e basi attenuata lanceolata, superne breviter acutata, 13–17 cent. longa, 30–45 mm. lata, perulae florales diu persistentes, extus albo lanatae, oblongae; flores 6–8, apice ramorum congesti, rubri; pedicelli 3–4 mm. longi; calycis glabri segmenta vix con-

a surface stratum of white desquamating wax or its vestiges. Foliage-leaf buds and juvenile leaves unknown. Leaves petiolate as much as 17·5 cm. long; lamina of consistence of parchment long lanceolate occasionally oblanceolate narrowed to both ends, as much as 16 cm. long and 4·5 cm. broad, apex acute or acuminate not beaked ending in a horny hydathodal tubercle, margin slightly recurved cartilaginous obscurely undulate and minutely marked by the bases of fallen juvenile hairs, base obtuse; upper surface olivaceous somewhat glossy, very glabrous, the midrib not reddening grooved, primary veins as many as 25 pairs hardly conspicuous, elsewhere conspicuously reticulate (in dry state); under surface tawny hardly punctulate very glabrous, midrib and primary veins elevated, the network of the ultimate veins reddish, the whole surface somewhat glossy smooth as if wax-varnished the coating in places obscuring the ultimate venation, epidermis epapillate; petiole thick about 1·5 cm. long wrinkled grooved above apparently glabrous but clad with a desquamating white (often blackening) stratum of wax. Flowers of the inflorescence about 8, racemosely umbellate, the axis of inflorescence about 1·5 cm. long densely tomentose with white floccose adpressed hairs; fertile bracts membranaceous tawny spathulate as much as 2 cm. long and 7 mm. broad, apex rounded or somewhat truncate and emarginate, ciliate, outside densely silky throughout, inside near apex in the middle silky; bracteoles filiform adpressed-pilose throughout about 1 cm. long; pedicels scarcely 1 cm. long glabrous brown. Calyx cupular minute about 1·5 mm. long outside glabrous; lobes deltoid sometimes broadly semi-lunate minutely fimbriate. Corolla red (?), tubular-campanulate as much as 4·3 cm. long exceeding the stamens and gynaeceum, outside and inside glabrous, red-spotted posteriorly, 5-lobed; lobes unequal posterior slightly larger

spicua; corolla 25–30 mm. longa, anguste campanulata 5-loba; ovarium, stylus totus et staminum filamenta 10, perfecte glabra; stamina et stylus haud exserta.

Vallée du Loukiang, à Tsékou (Soulié, n. 1000; 16 mars 1895).

Assez voisin du *Rh. arboreum* et des espèces du même groupe, c'est-à-dire de celles qui ont 10 étamines et une corolle à 5 lobes, mais distinct par l'état complètement glabre de l'androcée et du gynécée; le *Rh. Bonvaloti* auquel il ressemble surtout a le gynécée et l'androcée glanduleux.

about 1·5 cm. long and 2 cm. broad rounded emarginate more or less crenulate. Stamens 10 unequal, longer about 3·3 cm. shorter about 2 cm. long; anthers dark purple in longest stamens about 3 mm. long, in shortest 2 mm.; filaments slightly flattened at the base scarcely widened, glabrous throughout, eglandular. Disk pubescent. Gynaeceum about 3·8 cm. long slightly exceeding the stamens, shorter than corolla; ovary black-purple slightly grooved narrow cylindric about 8 mm. long by 2 mm. in diameter glabrous; style glabrous slightly clavately expanded under the lobulate stigma.

W.N.W. Yunnan:—Tseku. Valley of Loukiang. Soulié. No. 1000. 16th March 1895.

Franchet's diagnosis of this species, sufficient for its purpose at the time of publication, is inadequate now that we have so many more species to deal with in the Irroratum alliance. I have therefore drawn up this fuller description. For the means of doing this I am indebted to M. Lecomte of the Paris Herbarium, who has given himself much trouble on my behalf, for which I wish to express my warm thanks. I received from him a drawing of the type-sheet in the Paris Herbarium, and subsequently beautiful specimens of Soulié's collecting. Upon these my description is based.

The species finds its nearest ally in *Rh. ceraceum*, and comes naturally into the set which includes also *Rh. anthosphaerum* and *Rh. hylothreptum*. Like *Rh. ceraceum*, it has the peculiar wax covering over the under surface of the leaf, but the glossy sheen is not so bright. It appears to be a larger-leaved and larger-flowered plant than *Rh. ceraceum*. In the flower itself the unequal corolla lobes spotted posteriorly and the glabrous pedicels, calyx, stamens, and ovary are diagnostic. One may look on it as a glabrous edition of *Rh. ceraceum*.

Diels thought his *Rh. gymnanthum* to be similar to *Rh. lukiangense*, differing in, amongst other characters, its glabrous not tomentose pedicels. But the pedicels in both are glabrous. What Diels saw was the tomentose axis of inflorescence in *Rh. lukiangense*, and that is very different from the glabrescent rhachis of *Rh. gymnanthum*. Other characters separating the species are the wax-coated not floccose stems and petioles of *Rh. lukiangense*, its

glabrous not floccose pedicels, its glabrous not puberulous stamens, its pubescent not glabrous disk.

I will not quarrel with Franchet's ascription of *Rh. lukiangense* to the Arboreum group of Rhododendrons embracing "species with 5-lobed corolla and 10 stamens"—only the great increase in the number of known Rhododendrons since he wrote compels endeavour to find smaller phyletic groups within the genus, and the Irroratum series is a product. The Arboreum series of Rhododendron centering in the Himalayan *Rh. arboreum*, with its allied forms *Rh. Campbelliae*, *Rh. cinnamomeum*, *Rh. Kingianum*, *Rh. nilagiricum*, *Rh. Rollissonii*, and so forth, is represented in China by *Rh. Delavayi*, which also seems to have some distinct enough allied forms, and the series can be readily separated by valid marks as a phylum from the Irroratum series. It is true that the general habit of some members of the Irroratum series recalls the Arboreum habit, and there is also often the compact truss of red flowers, but the indumentum of the Arboreums has a very different construction from that of the Irroratums. This and the many other distinctions between the series I must leave over for another occasion of writing. Only one thing further will I say here, that no one of the Chinese Irroratums can compare in consistency of corolla and intensity of colour with *Rh. arboreum*. And this is not an isolated case in a comparison of the Rhododendrons of the two areas. As a whole the large Sikkim Rhododendrons bear the palm in these respects over the Chinese—only in some of the dwarfer Chinese forms is there rivalry.

Franchet also mentions *Rh. Bonvaloti*, Franch. as a species which *Rh. lukiangense* "specially resembles." I have knowledge of *Rh. Bonvaloti* only in a fragmentary specimen, and it would lead me to exclude it from the Irroratum series, but I shall have to deal with *Rh. Bonvaloti* at another time.

Rhododendron mengtszense, Balf. f. et W. W. Sm.[1]

Tree reaching a height of about 6 m. with slender branches covered with the agglutinated remains of seti-

[1] *Rhododendron mengtszense*, Balf. f. et W. W. Sm.—Arbor ad 6 m. alta tenuiramosa glandularum setiformium et cataphyllorum et bractearum annorum praeteritorum vestigiis agglutinatis obtecta. Rami apicem

form glands, scale-leaves, and bracts of previous years. Branches viscid towards the summit, about 4 mm. in diameter, densely clad with red clavate glands with long red stalks, setiform. Foliage buds unknown. Leaves petiolate reaching 18 cm. in length; lamina chartaceous firm narrowly oblanceolate as much as 16·5 cm. long 3·5 cm. broad narrowing to the somewhat beaked and acutish apex, margin cartilaginous obscurely undulate and somewhat rufous reddened by the bases of fallen hairs, narrowing to the unequal somewhat obtuse base; upper

versus viscidi circ. 4 mm. diam. glandulis rubris clavatis longe rubro-stipitatis setiformibus dense obsiti. Alabastra ignota. Folia petiolata ad 18 cm. longa; lamina chartacea firma anguste oblanceolata ad 16·5 cm. longa ad 3·5 cm. lata apice attenuata subrostratim acutiuscula margine cartilaginea obscure undulata et pedibus pilorum delapsorum subasperata deorsum attenuata basi inaequaliter obtusa supra opaca haud nitens olivacea costa media sulcata sulco pilis sebaceis et glandulis marcidis impleto venis primariis utrinsecus circ. 16 haud prominulis caeteroquin plana et primo aspectu glaberrima sed pedibus rubris glandularum vel pilorum floccosorum delapsorum minutissime punctulata et setis paucis conspersa subtus fulvida costa media venisque primariis elevatis erubescentibus ex toto glandulis rubris setiformibus et pilis sebaceis albidis vel rubris floccosis vel eorum vestigiis indutis venularum reti paullo conspicuo et similiter sparsim punctulato; petiolus ad 1·5 cm. longus crassus setis longis rubris tandem nigricantibus glandulosis densissime ex toto vestitus. Flores breviter racemoso-umbellati circ. 8 in inflorescentia quaque terminali rhachi circ. 1 cm. longa glanduloso-setosa; bracteae steriles rotundatae crustaceo-coriaceae intus plus minusve sericeo-puberulae margine tenuiores, fertiles late obovatae circ. 2 cm. longae supra circ. 1 cm. latae extus et intus sericeae eglandulosae margine apiceque pilis rubris fimbriatae; bracteolae lineares uninerviae adpresso-pilosae fere pedicellos aequantes; pedicelli ad 2 cm. longi crassi sub flore obliqui densissime glanduloso-setosi glandularum stipitibus rubris longis et brevibus. Calyx parvus circ. 2 mm. longus cupularis carnosulus, cupula dense glanduloso-setosa glandulis rubris, lobis deltoideis purpureis glabris. Corolla purpureo-rosea aperte campanulata circ. 3·8 cm. longa extus intusque glabra postice varo basali coccineo notata emaculata basi 5-gibbosa retusa 5-lobata, lobis circ. 1·6 cm. longis circ. 2 cm. latis rotundatis emarginatis subcrenulatis. Stamina 10 inaequalia, longiora circ. 3 cm. longa breviora circ. 1·5 cm. antheris circ. 4 mm. longis brunneis, filamentis deorsum paullo latioribus a basi ima ad apicem ovarii puberulis. Discus albido-pubescens. Gynaeceum circ. 3·8 cm. longum; ovarium circ. 5 mm. longum cylindricum profunde sulcatum nigrescens glandulis rubris plurimis longe rufo-stipitatis subadpressis densissime obtectum et setis paucioribus longis (circ. 4 mm.) sebaceis rufis adscendentibus acutatis intermixtis praeditum; stylus ex toto rubro-glandulosus glandulis inferis longe superis breviter stipitatis sub stigmate lobulato vix expansus.

Species *Rh. gymnantho*, Diels affinis ramulis et petiolis et inflorescentiae rhachi et pedicellis et calyce et ovario glanduloso-setosis, foliis supra opacis haud nitentibus, pedicello 2 cm. longo, disco pubescente, stylo glanduloso facile recognoscenda.

surface mat not glossy, olivaceous, midrib grooved the groove more or less filled with withered greasy hairs and glands, primary veins about 16 pairs not prominent, surface elsewhere flat and at first glance very glabrous but minutely punctulate by the red bases of glands or floccose hairs, some setiform glands may be seen about the midrib towards the base; under surface tawny somewhat glossy the midrib and primary veins raised and reddening covered throughout by red setiform glands and greasy white or red floccose hairs or by their vestiges, network of the ultimate veins slightly conspicuous and sparingly punctulate; petiole reaching 1·5 cm. in length thick, clad throughout with long red glandular blackening setae. Flowers shortly racemose-umbellate about 8 in each terminal truss, axis of inflorescence about 1 cm. long glandular setose; sterile bracts rounded crustaceously coriaceous, more or less sericeo-puberulous inside, thinner at the margin, fertile bracts broadly obovate about 2 cm. long 1 cm. broad, outside and inside sericeous eglandular, margin and apex fimbriate with red hairs; bracteoles linear almost equalling the pedicels one-nerved with adpressed long hairs; pedicels reaching 2 cm. long thick, oblique under the flower, very densely gland-setose the glands having red stalks some long some short. Calyx small about 2 mm. long cupular fleshy, the cup densely gland-setose with red glands, lobes deltoid purple glabrous. Corolla purple-rose openly campanulate about 3·8 cm. long, glabrous both outside and inside marked at the base inside by a crimson blotch unspotted, with 5 basal gibbosities retuse, 5-lobed; lobes about 1·6 cm. long 2 cm. broad rounded emarginate subcrenulate. Stamens 10 unequal, the longest about 3 cm. long the shortest about 1·5 cm. long; anthers 4 mm. long brown; filaments widening to the base and from there to the top of the ovary puberulous. Disk whitely pubescent. Gynaeceum about 3·8 cm. long; ovary about 5 mm. long cylindric deeply grooved blackening covered with many red long-stalked setulose glands and with a smaller number of long setae (as much as 4 mm. long) which are sebaceous and red ascending sharp-pointed; style throughout red-glandular the lower glands with long stalks, the upper ones with shorter, hardly expanded under the lobulate stigma.

S.E. Yunnan:—Mengtsz. Mountain forests to south-east. 7000 ft. Tree 20 ft. Flowers purple-red. Henry. No. 10,275. In Herb. Kew et Edin.

A species with the general characters of the Irroratum series, and probably approaching most nearly to *Rh. gymnanthum*, Diels. It has the long narrow leaves of that species, but a glance suffices to distinguish them. Here the upper surface of the leaves is a mat dull olive-green, in *Rh. gymnanthum*, Diels the upper surface is a bright glossy glaucous green. Then the remarkable development of glandular setae is a feature not seen in *Rh. gymnanthum*, nor, indeed, in any other of the Irroratum series. These setae form a thick persistent sheath on the petioles and stems and on the ovary are most striking. All the setae are not glandular, some of them have pointed ends, and are much longer than those with glands reaching in length as much as 4 mm. The leaf-surfaces at maturity are conspicuously red-punctulate, more so indeed (particularly the upper surface) than in some others of the Irroratum series. The glands themselves are frequently persistent, especially on the primary veins, and the flocks of greasy hairs are also often persistent, particularly on or about the midrib and markedly towards its base. In the last-mentioned character *Rh. mengtszense* recalls its ally *Rh. araiophyllum*, where the flocks remain sometimes as a dense tomentum.

By its openly campanulate corolla it also differs from *Rh. gymnanthum*, where the corolla is funnel-shaped, and, in addition to the setose ovary already mentioned, the glandular style marks it off from *Rh. gymnanthum*, in which both ovary and style are glabrous.

Diagnostic characters separating *Rh. mengtszense* from *Rh. irroratum* are no less conspicuous. These are the longer and narrower leaves, the gland-setose indumentum, the corolla without glands outside and glabrous inside, and the pubescent disk.

Hemsley and Wilson[1] take this plant with others (Nos. 10,301, 10,853, 11,066, 11,067, 11,067B) of Henry's collecting in S.E. Yunnan to be *Rh. irroratum*, Franch., associating with it also a Tseku specimen No. 4 of Monbeig and Forrest's Nos. 2043, 2058, 4146. Rehder and Wilson[2] refer

[1] In Kew Bull. (1910), 112. [2] Plantae Wilsonianae, i (1913), 539.

Monbeig's plant to *Rh. gymnanthum* and make the suggestion that Henry's No. 10,275 (our *Rh. mengtszense*) and the other Henryan plants mentioned (they say nothing about 10,301) "might be considered as constituting a pubescent variety of *Rh. gymnanthum*." Rehder and Wilson are right in identifying Monbeig's No. 4 as *Rh. gymnanthum*, and in bringing Henry's No. 10,275 nearer to *Rh. gymnanthum* than to *Rh. irroratum*; but there is not identity between any of Henry's specimens and either *Rh. gymnanthum* or *Rh. irroratum*. They can all be separated by quite satisfactory characters as distinct species, and I am describing some of them in these pages. Henry's specimens are to be identified thus:—

No. 10,275 is *Rh. mengtszense*, Balf. f. et W. W. Sm.

No. 10,301 is probably the same as Hancock's No. 179 from Mengtsz, but the material is inadequate. See what I say on p. 173.

No. 10,853 is *Rh. spanotrichum*, Balf. f. et W. W. Sm.

No. 11,066 is *Rh. pogonostylum*, Balf. f. et W. W. Sm.

No. 11,067 is *Rh. adenostemonum*, Balf. f. et W. W. Sm.

No. 11,067B is fruiting specimen of No. 11,066.

I am indebted to the Director of Kew for the loan of Henry's specimens for examination.

Rhododendron pogonostylum, Balf. f. et W. W. Sm.[1]

Small tree reaching 4–5 m. in height with medium thick branches. Branches a year old dirty grey colour enclosed

[1] *Rhododendron pogonostylum*, Balf. f. et W. W. Sm.—Arbor parva ad 4·5 m. alta ramis crassiusculis. Ramuli annotini sordide grisei glandulis paucis clavatis rubris nigricantibus breviter stipitatis et pilis plurimis floccosis cinereo-marcidis stratum compactum facientibus induti tandem glabrescentes flavido-virides et glandularum detersilium cicatricibus punctulati. Alabastra ignota. Folia petiolata ad 14 cm. longa; lamina rigide coriacea oblongo-lanceolata vel oblongo-ovata ad 12 cm. longa ad 4·5 cm. lata apice attenuata acuta nunc subrostrata tuberculo parvo atro-rubente corneo terminata margine cartilaginea leviter recurva undulata et cicatricibus subasperata basi obtusa vel subrotundata supra olivacea vel fulvo-olivacea opaca costa media sulcata sulco pilis floccosis et glandulis paucis marcidis plus minusve impleto venis primariis utrinsecus ad 16 subsulcatis caeteroquin plana evenulosa primo aspectu glabra sed pilorum floccosorum glandularumque vestigiis notata subtus helvola costa media venisque primariis elevatis paullo erubescentibus venularum reti nunc plus minusve prominulo ubique glandularum (an pilorum?) pedibus rubris punctulata; petiolus crassiusculus ad 2 cm. longus supra sulcatus strato sordide cinereo pilorum floccosorum marci-

in an indumentum composed of a few clavate red blackening shortly-stalked glands and very many floccose greyish withered hairs, ultimately glabrescent and yellow-green, punctulate with cicatrices of the fallen glands. Foliage buds unknown. Leaves petiolate as much as 14 cm. long; lamina rigid somewhat thickened coriaceous oblong-lanceolate or oblong-ovate as much as 12 cm. long and 4·5 cm. broad narrowed to the acute apex which is sometimes somewhat beaked and ends in a small dark-red horny tubercle, margin cartilaginous slightly recurved and roughened by scars of fallen glands or hairs, base obtuse or somewhat rounded; upper surface olivaceous or

dorum plus minusve vestitus plerumque glabrescens. Flores breviter racemoso-umbellati circ. 8 in quaque inflorescentia rhachi vix 1 cm. longa rufo-floccosa; bracteae fertiles spadiceo-brunneae late oblongo-spathulatae circ. 2·5 cm. longae circ. 1·5 cm. latae apice rotundatae vel subtruncatae saepe mucronatae rufo-ciliatae centro coriaceae margine submembranaceae et ciliatae intus (dimidio infero excepto) extusque dense piloso-sericeae; bracteolae filiformes aurantiacae pedicellis breviores adpresso-pilosae; pedicelli validi ad 8 mm. longi saepe breviores apice obliqui glandulis plurimis rubris longe et breviter stipitatis et pilis sebaceis floccosis paucioribus vestiti. Calyx minutus cupularis circ. 1·5 mm. longus fere ad basim in lobos 5 carnosulos late ovatos fissus ubique extus rubro-glandulosus et pilis sebaceis rufis floccosis copiose obsitus margine glanduloso-ciliatus. Corolla pallide rosea tubuloso-campanulata circ. 4·5 cm. longa saepe minor circ. 3·5 cm. longa extus basi puberula et ad venulas supra glandulis paucis praedita intus puberula et postice atrorubro-maculata evariculata basi 5-gibbosa, 5-lobata, lobis rotundatis emarginatis subcrenulatis in floribus majoribus circ. 1·8 cm. longa et 2·5 cm. lata. Stamina 10 inaequalia in floribus majoribus longiora circ. 3 cm. longa breviora circ. 2 cm. antheris circ. 2 mm. longis, filamentis deorsum expansis a basi ima sursum ultra medium dense pubescentibus eglandulosis. Discus glaber. Gynaeceum in floribus majoribus circ. 3·8 cm. longum; ovarium conoideum paullo sulcatum nigrescens circ. 6 mm. longum circ. 3 mm. diam. dense floccoso-pilosum pilis albidis vel rufo-sebaceis a basi strictim et adscendentim ramosis glandulas clavatas aurantiacas breviter stipitatas pauciores intermixtas obtegentibus et occludentibus; stylus gracilis ut ovarium pilis et glandulis ex toto dense (vel ad medium laxius) obtectus sub stigmate subspongioso subdiscoideo haud ampliatus. Capsula leviter curvata circ. 4 cm. longa circ. 1 cm. diam. glabrescens nigra indumenti juvenilis collapsi vestigiis plus minusve praedita, calyce cupulari persistente paullo aucto basi cincta, stylo delapso. Semina oblonga complanata circ. 3 mm. longa 1 mm. diam. rufo-aurantiaca circumcirca alata et caruncula chalazali albida cristata.

Species *Rh. irrorato*, Franch. affinis sed foliis majoribus oblongo-lanceolatis vel oblongo-ovatis nec oblanceolatis, petioli indumento persistentiore, inflorescentiae rhachi rufo-floccosa, pedicellis vix 1 cm. longis glandulosis et floccosis, calyce glanduloso et floccoso, corolla basi extus puberula, staminum filamentis ad medium vel ultra pubescentibus, ovario et stylo ex toto pilis sebaceis floccosis glandulas occludentibus dense (stylo nunc partim et laxius) vestito distinguenda.

tawny-olive mat with a grooved midrib, the groove being more or less filled with withered floccose hairs and glands, primary veins about 16 pairs slightly sulcate, leaf-surface elsewhere flat veinless at first sight glabrous but marked by the vestiges of the floccose hairs and glands which have fallen: under surface yellowish buff with the midrib and primary veins raised and slightly reddening, network of the veinlets sometimes more or less prominent everywhere punctulate with the red bases of glands (or hairs); petiole thickish about 2 cm. long grooved above more or less clad by a dirty grey stratum of withered floccose hairs, commonly glabrescent. Flowers in a short racemose-umbel about 8 in each inflorescence with a rufous floccose rhachis scarcely 1 cm. long; fertile bracts chestnut-brown broadly oblong spathulate about 2·5 cm. long and 1·5 cm. broad rounded or subtruncate at the base often mucronate ruf-ously ciliate, the central part somewhat coriaceous and girt by a somewhat membranous ciliate marginal area, on the inside (except in the lower half) and outside densely pilose sericeous; bracteoles thread-like orange-coloured shorter than the pedicels covered with adpressed hairs; pedicels stout as much as 8 mm. long, often shorter, oblique at the apex, clad with many red both long- and short-stalked glands and fewer greasy floccose hairs. Calyx minute cupular about 1·5 cm. long cut almost to the base into 5 fleshy broadly ovate; lobes everywhere on the outside red gland-ular and abundantly covered by greasy red floccose hairs, margin of the lobes glandular ciliate. Corolla pink tubular-campanulate 4·5 cm. long often less (about 3·5 cm.), outside at the base puberulous and sprinkled with glands on the veins higher up, inside puberulous and spotted dark red on the back without a blotch, base retuse and 5-gibbous, 5-lobed; lobes rounded emarginate subcrenulate about 1·8 cm. long and 2·5 cm. broad in the larger flowers. Stamens 10 unequal, in the larger flowers the longer ones about 3 cm. long shorter about 2 cm.; anthers about 2 mm. long; filaments expanded towards the base and from there to beyond the middle densely pubescent but eglandular. Disk glabrous. Gynaeceum in the larger flowers about 3·8 cm. long; ovary conoid slightly grooved blackening about 6 mm. long and 3 mm. in diameter densely floccose

with very many white or rufous greasy hairs stiff and branching from the base, these form the upper stratum of indumentum covering a lower one of clavate orange-coloured shortly-stalked glands which are fewer in number than the hairs; style slender and like the ovary covered throughout with hairs and glands (rarely only to the middle and then with fewer hairs and glands); stigma somewhat spongy and somewhat discoid and the style is not much expanded below it. Capsule slightly curved about 4 cm. long and 1 cm. broad glabrescent and black but possessing the remains of the collapsed indumentum of the ovary, girt at the base by the persistent slightly enlarged cupular calyx. Seeds oblong flattened about 3 mm. long and 1 mm. broad of a reddish-orange colour winged all round and with a chalazal white crest.

S.E. Yunnan:—Mengtsz. N. mountains, forests. 7000 ft. Tree 15 ft. Flowers pink. Henry. No. 11,066; 8500 ft. Tree 10 ft. Henry. No. 11,067B. In fruit. In Herb. Kew.

This Henryan plant from the S.E. of Yunnan is certainly nearest to *Rh. irroratum*, Franch. in the Irroratum series. It has the rigid leaves with prominently undulate margin of that species, but the leaf-form is somewhat divergent. The lamina is wider below than above the middle, becoming at times somewhat narrowly ovate or oblong ovate with a rounded base. The petioles retain the juvenile indumentum much longer—it may be found upon them until they fall, so that the petiole does not appear so completely glabrous as it does in *Rh. irroratum*. Then the inflorescence rhachis is quite floccose, not purely glandular as in *Rh. irroratum*; the pedicels are usually under 1 cm. long and intensely floccose as well as glandular, as is the calyx—in *Rh. irroratum* there are no flocks. The tubular-campanulate corolla shows a character not seen in others of the Irroratum series—it is puberulous at the base outside, at the same time it has a sprinkling of glands upon the veins as in *Rh. irroratum*. The staminal filaments are pubescent to the middle and beyond not only finely puberulous at the base as in *Rh. irroratum*; they are also eglandular—a distinguishing character from *Rh. adenostemonum*. The ovary is quite covered with branched usually greasy floccose hairs so densely that an underlying layer of clavate

glands is entirely concealed, and this indumentum extends typically to the top of the style, a condition very different from the purely red-glandular ovary and style of *Rh. irroratum*. In one flower I found the indumentum of the style extending only half-way up it, and the densely bearded character was hardly developed, the flocks and glands being fewer and distant.

Rh. adenostemonum is an ally, but there we have a more purely glandular type, wanting the very pronounced flocks on the style, having neither glands nor hairs on the outside of the corolla and showing glands on the staminal filaments.

The two specimens in the Kew Herbarium—one in flower, one in fruit—are the only ones I know of.

Rhododendron spanotrichum, Balf. f. et W. W. Sm.[1]

A small tree reaching about 6 m. in height. Branches not very thick. Branches a year old as much as 3 mm. in

[1] *Rhododendron spanotrichum*, Balf. f. et W. W. Sm.—Arbor parva ad 6 m. alta ramis haud crassis. Ramuli annotini ad 3 mm. diam. pallide virides glabri glandularum (an floccorum ?) detersarum pedibus rubris tandem nigricantibus minute punctulati. Alabastrorum oblongo-ovoideorum obtusorum circ. 5 mm. diam. perulae plus minusve viscidae glandulis rubris sessilibus extus praeditae exteriores parvae semi-lunatae et rotundatae circ. 3 mm. longae et latae crustaceo-coriaceae brunneae intus basi apiceque adpresso-puberulae margine minute glanduloso-fimbriatae vel breviter glanduloso-pilosae interiores oblongo-ovatae vel oblongo-ellipticae obtusae viscidae. Folia petiolata ad 13·5 cm. longa : lamina coriacea oblanceolata ad 12 cm. longa ad 4 cm. lata apice subro-stratim attenuata vel breviter acuminata mucronulata margine cartilaginea obscure undulata subplana cicatricibus glandularum (an pilorum ?) detersarum subasperata basi obtusa vel late cuneata saepe inaequalis supra pallide vel atro-olivacea saepe brunnescens opaca haud nitens costa media sulcata venis primariis utrinsecus circ. ad 18 inconspicue sulcatis caeteroquin laevis glaberrima sed glandularum detersarum pedibus vestigialibus minute rubro-punctulata subtus helvola vel rubro-brunnea subnitens costa media venisque primariis leviter erubescentibus conspicue elevatis venularum reti paullo eminente ubique primo aspectu glabra sed glandularum detersarum pedibus vestigialibus rubro-punctulata ; petiolus ad 1·5 cm. longus crassus supra sulcatus erubescens glabrescens ut lamina rubro-punctulatus. Flores racemoso-umbellati circ. 10 in quaque inflorescentia rhachi circ. 1·8 cm. longa glabra ; bracteae extimae steriles ovatae vel subrotundatae crasso-coriaceae margine tenuiores extus pubescentes vel subsericeae et sparsissime apicem versus rubro-glandulosae fertiles obovato-spathulatae apice truncatae vel rotundatae mucronatae ad 2·6 cm. longae ad 1·6 cm. latae extus dense et grosse adpresso-pilosae ; bracteolae filiformes rubiginosae circ. 1·5 cm. longae pedicellis multo longiores sericeo-pilosae ; pedicelli circ. 7 mm. longi crassi pilis floccosis sebaceis rufis plus minusve praediti. Calyx minutus

diameter pale green glabrous minutely punctulate with the red (finally blackening) bases of fallen glands (or flocks). Scale-leaves of the oblong ovoid obtuse about 5 mm. in diameter foliage-leaf buds more or less viscid and furnished with red sessile glands; outer scale-leaves small semi-lunate and rounded about 3 mm. long and broad crustaceously coriaceous, brown, inside at the base and apex adpressed puberulous, margin minutely gland-fimbriate or shortly gland-pilose; inner scale-leaves oblong-ovate or oblong-elliptic obtuse viscid. Leaves petiolate as much as 13·5 cm. long; lamina coriaceous or thickly chart-aceous oblanceolate as much as 12 cm. long and 4 cm. broad narrowed to the somewhat beaked or shortly acuminate apex, mucronulate, margin cartilaginous obscurely undulate somewhat flat slightly roughened by the cicatrices of fallen glands, base obtuse or widely cuneate often unequal; upper surface pale or dark olive-green often becoming brown, mat not glossy with a grooved midrib, the primary veins about 18 pairs inconspicuously grooved, the rest of the surface smooth very glabrous but minutely red-punctulate from the persistent bases of fallen glands; under surface yellowish-buff or greyish-brown or reddish-brown somewhat glossy, the midrib and primary veins slightly reddening and con-spicuously raised, the network of the veinlets slightly raised, everywhere at first sight glabrous but punctulate with the red bases of fallen glands; petiole as much as 1·5 cm. long thick sulcate above, reddening glabrescent, red-punctulate like the lamina. Flowers racemose-umbellate about 10 in each inflorescence the axis about 1·8 cm. long glabrous;

circ. 1·5 mm. longus cupularis glaber vel pilis sebaceis rufis floccosis paucis conspersus, lobis vix conspicuis deltoideis vel ovatis efimbriatis. Corolla kermesina campanulata circ. 4·5 cm. longa extus intusque glabra postice varo magno atro-kermesino notata emaculata 5-retuso-gibbosa 5-lobata, lobis circ. 2 cm. longis circ. 2·5 cm. latis subellipticis vel rotundatis emarginatis subcrenulatis. Stamina 10 inaequalia longiora circ. 3·6 cm. longa antheris circ. 4 mm. longis breviora 1·6 cm. longa antheris circ. 3 mm. longis, filamentis basi dilatatis glabris. Discus glaber. Gynaeceum circ. 3·6 cm. longum; ovarium conoideum leviter sulcatum nigrescens obscure transverse areolatum circ. 5 mm. longum pilis sebaceis rubris floccosis sparsissime conspersum; stylus glaber sub stigmate lobulato purpureo vix ampliatus.

Species *Rh. gymnantho*, Diels affinis sed foliis brevioribus et latioribus supra opacis, inflorescentiae rhachi glabra, calycis lobis efimbriatis, corolla campanulata, staminum filamentis glabris, ovario sparsissime floccoso distinguenda.

outer sterile bracts ovate or somewhat rounded thick and coriaceous thinner at the margin, outside pubescent or somewhat sericeous and at the apex sparingly red-glandular: fertile bracts obovate-spathulate truncate or rounded and mucronate at the apex as much as 2·6 cm. long 1·6 cm. broad outside densely and coarsely adpressed-pilose: bracteoles filiform rusty-red about 1·5 cm. long much longer than the pedicels and silkily hairy: pedicels about 7 mm. long thick furnished more or less with rufous greasy floccose hairs. Calyx minute about 1·5 mm. long cupular glabrous or sprinkled with a few greasy rufous floccose hairs: lobes scarcely conspicuous deltoid or ovate efimbriate. Corolla crimson campanulate about 4·5 cm. long glabrous outside and inside with a large dark crimsom blotch at the back without any spots, at the base 5-gibbous and retuse, 5-lobed; lobes about 2 cm. long and 2·5 cm. broad, somewhat elliptic or rounded emarginate and somewhat crenulate. Stamens 10 unequal the longer about 3·6 cm. long with anthers about 4 mm. long, the shorter about 1·6 cm. long with anthers about 3 mm. long: filaments dilated at the base and glabrous. Disk glabrous. Gynaeceum about 3·6 cm. long; ovary conoid slightly sulcate blackening obscurely and transversely areolate about 5 mm. long most sparingly sprinked with greasy red floccose hairs; style glabrous scarcely expanded under the purple lobulate stigma.

S.E. Yunnan:—Fengchenlin Mountains. 7500 ft. Tree 20 ft. Flowers crimson. Henry. No. 10,853. Herb. Edin. et Kew.

Rh. spanotrichum is one of the Henryan plants from the region of Mengtsz, formerly regarded by Hemsley and Wilson [1] as *Rh. irroratum*, Franch. They point out, however, that it differs "from typical *Rh. irroratum* in the filaments and ovary being glabrous or nearly so." Subsequently Rehder and Wilson [2] brought it more correctly to the vicinity of *Rh. gymnanthum*, Diels. See under *Rh. mengtszense*, p. 209.

The plant is neither *Rh. gymnanthum* nor *Rh. irroratum*. It has in some measure the glaucousness of foliage that

[1] In Kew Bulletin (1910), 112.
[2] Plantae Wilsonianae, i (1913), 539.

marks *Rh. irroratum*, but the oblanceolate form of the leaf is much more marked here and the tip is more definitely beaked or shortly acuminate. Then the flowers are red not white or yellow-white tinged with rose as in *Rh. irroratum*, the inflorescence rhachis is glabrous not glandular, the pedicels are under not over 1 cm. long, the calyx is glabrous or sparingly floccose not glandular, the campanulate corolla (not tubular-campanulate) has no glands on the outside and is glabrous not hairy inside, the staminal filaments are glabrous not finely puberulous at base, the ovary is very sparingly floccose not densely glandular, and the style is glabrous not glandular.

The relationship to *Rh. gymnanthum* is closer than to *Rh. irroratum*, and the species is a distinct member of that set within the Irroratum series which are grouped under Gymnanthum. See p. 171, where diagnostic characters are given.

Rhododendron tanastylum, Balf. f. et Ward.[1]

A medium-sized scraggy bush or more generally a thin tree of about 6 m. in height living well inside the rain-

[1] *Rhododendron tanastylum*, Balf. f. et Ward.—Arbor tenuis ad 6 m. alta vel frutex macer, silvarum pluvialium incola, ramis tenuibus. Ramuli annotini circ. 1·5 mm. diam. pilis floccosis albidis plus minusve induti glabrescentes tandem rubro-purpurei punctulati dein sordide grisei decorticantes. Alabastra matura foliorum ignota. Folia petiolata ad 13·5 cm. longa; lamina chartacea late lanceolata vel oblanceolata ad 12 cm. longa ad 4·3 cm. lata apice attenuata nunc breviter subacuminata nunc obtusa subrostrata tuberculo corneo parvo terminata margine cartilaginea recurvata undulata cicatricibus obscure subasperata basi obtusa vel subcuneata supra olivacea vel brunneo-olivacea opaca costa media sulcata sulco pilorum vestigiis plus minusve praedito venis primariis utrinsecus circ. 16 et venularum reti inconspicuis caeteroquin laevis glabra sed floccorum juvenilium vestigiis obscure notata, subtus pallidior saepe fulva subnitens costa media erubescente et venis primariis elevatis pedibus rubris floccorum (an glandularum ?) detersorum punctulatis caeteroquin glabra; petiolus ad 1·5 cm. longus saepius brevior crassus rubro-purpureus supra sulcatus plus minusve floccosus sed glabrescens. Flores racemoso-umbellati circ. 8 in quaque inflorescentia rhachi tenui ad 2 cm. longa furfuracea; bracteae deciduae ignotae; bracteolae filiformes rufescentes circ. 8 mm. longae pedicellis breviores sericeo-pilosae; pedicelli ad 1 cm. longi validi atro-purpurei pilis floccosis brevibus sparsissime conspersi vel glabri. Calyx minutus cupularis carnosulus circ. 2 mm. longus cupula glabra, lobis 5 late ovatis extus glabris margine pilis sebaceis sparsim ciliatis. Corolla intense kermesina tubuloso-campanulata ad 4·5 cm. longa 5-gibbosa retusa extus eglandulosa epilosa intus glabra et postice varo maculisque pluribus notata 5-lobata, lobis rotundatis emarginatis subcrenulatis circ. 1·7 cm.

forest. Branches slender. Branchlets a year old about 1·5 mm. in diameter clad more or less with white floccose hairs glabrescent ultimately becoming reddish-purple and punctulate; then dirty grey and shedding the bark. Mature buds of foliage-leaves unknown. Leaves petiolate as much as 13·5 cm. long; lamina papery broadly lanceolate or oblanceolate as much as 12 cm. long and 4·3 cm. broad, narrowed to the apex and sometimes shortly acuminate sometimes obtuse and somewhat beaked terminated by a small horny tubercle, margin cartilaginous recurved undulate somewhat roughened by the scars of fallen appendages, obtuse or subcuneate at the base; upper surface olivaceous or brown-olivaceous mat, midrib grooved, the groove more or less lined by vestiges of hairs, primary veins about 16 pairs, the ultimate reticulation of the veinlets inconspicuous, the whole surface smooth and apparently glabrous but obscurely marked by the vestiges of young flocks; under surface paler often tawny somewhat glossy, the reddening midrib and the primary veins raised punctulate by the red bases of fallen flocks (or glands ?) rest of the surface glabrous; petiole as much as 1·5 cm. long more often shorter thick reddish-purple grooved above more or less floccose but glabrescent. Flowers racemose-umbellate about 8 in each inflorescence which has a slender scurfy rhachis reaching 2 cm. long; bracts deciduous unknown; bracteoles filiform rufescent about 8 mm. long shorter than the pedicels silkily hairy; pedicels about 1 cm. long stoutish blackish-purple most sparingly sprinkled with short floccose hairs or glabrous. Calyx minute cupular fleshy about 2 mm. long, the cup glabrous; lobes 5 broadly ovate glabrous outside, margin sparingly ciliate with greasy hairs. Corolla crimson

longis circ. 2 cm. latis. Stamina 10 inaequalia longiora circ. 3 cm. longa breviora circ. 1·5 cm. longa corolla styloque multo breviora antheris circ. 2·5 mm. longis, filamentis basi vix latioribus glabris. Discus glaber. Gynaeceum ad 4·2 cm. longum corolla paulo brevius; ovarium circ. 7 mm. longum cylindricum glabrum nigrescens leviter sulcatum obscure papillato-tuberculatum; stylus longus stamina longe superans glaber in stigma purpurascens lobulatum paullo ampliatus.

Species *Rh. araiophyllo*, Balf. f. et W. W. Sm. proxima foliis latioribus subtus punctulatis, pedicellis (sub 1 cm.) multo minoribus, inflorescentiae rhachi furfuracea, corolla intense kermesina tubuloso-campanulata quadrante majore, staminum filamentis glaberrimis, ovario glabro, stylo longo fere corollam aequante facile recognoscenda.

tubular-campanulate as much as 4·5 cm. long, at the base 5-gibbous and retuse, outside glandless and hairless, inside glabrous and marked on the back by a blotch and many spots, 5-lobed; lobes rounded emarginate subcrenulate about 1·7 cm. long and 2 cm. broad. Stamens 10 unequal the longer about 3 cm. long the shorter about 1·5 cm. long, much shorter than the corolla and style; anthers about 2·5 mm. long; filaments scarcely widened at the base glabrous. Disk glabrous. Gynaeceum as much as 4·2 cm. long very slightly shorter than the corolla; ovary cylindric about 7 mm. long blackening glabrous slightly grooved obscurely papillate and tuberculate: style glabrous long far exceeding the stamens slightly expanding into the purple lobulate stigma.

E. Upper Burma:—Hpimaw. 9000–10,000 ft. Medium-sized scraggy bush or more generally thin tree of 20 ft., well inside rain-forest. Flowers crimson. F. Kingdon Ward. No. 1566. 19.5.14.

This species is the only one known outside Yunnan of the Irroratum series, and it is most like *Rh. araiophyllum*, Balf. f. et W. W. Sm. of the Shweli-Salween divide—the species of the series nearest to it geographically. With *Rh. araiophyllum* it differs from some others of the Irroratum series in its very thin twigs, in the general absence of glands, and in the smaller flower-truss with thin axis. It is readily told from *Rh. araiophyllum*, the under-leaf surface in which is not punctulate and which has also longer pedicels, a hairy rhachis to the inflorescence, an openly campanulate smaller white corolla, pubescent staminal filaments, a puberulous ovary, and a style hardly longer than the stamens.

Our species falls, as I have pointed out above (see p. 171) into the set of Gymnanthum. When describing *Rh. araiophyllum* (see p. 186), I said that its relationships to *Rh. gymnanthum*, Diels must not be overlooked. The relationships of *Rh. tanastylum* to *Rh. gymnanthum* are nearer, yet the two plants are not the same species. Foliage and habit characters distinguish them at once. If we knew enough we might be able to correlate these with habitats —*Rh. gymnanthum* a plant of "open rocky situations," *Rh. tanastylum* from "well within the rain forest." In

Rh. gymnanthum, which Forrest describes as a "shrub of 3–6 ft.," the leaves are long (as much as 19 cm.) narrowly (in the longest leaves some 3·5 cm. broad) lanceolate and willow-like, with a slight curvature in the direction of sickle shape, and the upper surface is glaucous green conspicuously glossy. In *Rh. tanastylum*, which Ward speaks of as a "medium-sized scraggy bush or more generally thin tree of 20 ft.," the leaves do not show a length beyond 13·5 cm. and their width is 4·3 cm.; they are therefore much shorter, their width is greater in relation to their length, and their general form runs from lanceolate and broadly lanceolate to lanceolate oval sometimes oblanceolate oval, and there is no curvature; their upper surface is dark olive-green or brownish-olive and the under surface is darker. The leaf margin in *Rh. gymnanthum* is nearly flat and its undulations are not conspicuously developed, but in *Rh. tanastylum* the margin is prominently recurved and the undulations give an appearance of crenulation. In the flower region the inflorescence-rhachis becomes glabrous and smooth in *Rh. gymnanthum* but may retain a few floccose hairs; in *Rh. tanastylum* it develops a curious furfuraceous surface, giving the impression of very minute puberulousness. The pedicels in *Rh. gymnanthum* are more slender; its corolla is funnel-shaped campanulate not tubular-campanulate and is somewhat shorter; the staminal filaments are puberulous. Our specimens of both plants are scanty and have neither foliage nor flower-buds nor yet fruits, and the flower material of *Rh. tanastylum* is particularly small in amount. What we have suffices to distinguish the species, although it is inadequate for their complete description.

Since this paper was read and printed, additional species of the Irroratum section have become known. They are:—

Rh. eriogynum, Balf. f. et Ward.	E. Upper Burma.	Fen-Shin-Ling Camp. 8000–9000 ft. (Ward.)
Rh. facetum, Balf. f. et W. W. Sm.	Mid. W. Yunnan.	Ghi Shan, E. of Tali Lake. 9000 ft. (Forrest.)

Specimens of *Rh. Kendrickii*, Nutt., collected by R. E. Cooper in Bhutan, which I have examined, tell me that its affinity is with the Irroratum series and not with *Rh. arboreum*, Sm.

Observations on Rhododendron Seedlings.

By Professor Bayley Balfour, F.R.S.

(Read 12th April 1917.)

But little information is to be found in botanical books about the seedlings of Rhododendrons. Lord Avebury in his book On Seedlings mentions one species only—*Rh. arboreum*. We have at present in the Royal Botanic Garden an assemblage of Rhododendron seedlings more varied perhaps than is to be found elsewhere, and upon this what I am to say is based. Whilst the earliest stages of extraseminal development are uniform in the genus, the features of the epicotyl through its juvenile stages show divergences, which we may in time be able to correlate with both phyletic and œcologic factors. In this record of observations I have specially in view to point out characters of transition that appear in the seedlings of species which, as adults, possess an underleaf-indumentum conveniently termed tomentose in the loose terminology of systematic description.

My attention was first focussed upon the phenomenon I am about to mention by finding that plantlets raised from seed—of the correct naming of which there was no room for doubt—did not show, even in a fifth year of growth in some cases, the technical character of leaf-indumentum which belonged to the species at maturity. That the assumption of adult form by a plantlet may be long delayed is now a commonplace of botanical teaching, to be illustrated by examples from the most diverse families of plants, and reaching even the stage of a permanent juvenility, but I had no knowledge of its occurrence amongst Rhododendrons, nor indeed amongst Ericaceae.

In the seedlings to which I am referring the foliage-leaves of the early years of growth—which in the matter of shape may be rightly described as miniature of the adult—have the undersurface coloured an intense, often very dark, red due to the presence of anthocyanin pigment, which develops not only in the epidermis, but also in the mesophyll. Commonly too the surface is sprinkled with capitate

stalked glands, and may be really sticky. As the shoot ascends and years pass—the number varies much and is doubtless affected by the environment—the redness on new leaves lessens, and even to the extent that the underleaf may be quite green. Then comes the stage when the indumentum begins to appear on the new leaves, starting frequently from about and around the midrib, not forming a complete coating, so that leaves with indumentum in varying amount on a green surface, blotched as it were by it, may be found in years preceding the formation of leaves with a complete indumental layer. In some cases there may be an abrupt passage from the surface without tomentum to the leaf with full tomentum. In others the leaf, without becoming green beneath, may form a blotched or complete indumentum atop the reddened underleaf surface. The glands if present on the young leaf may be developed under the indumentum on the old or may be absent.

My observations are as yet too few and unsystematised to permit of the framing of a classification of species according to the resemblances and differences they exhibit in the character. Nor am I able, in the present nebulous state of phyletic grouping in the genus, to say in what degree the character has importance as a mark of relation. All I propose to do here is to name some illustrative examples of species in which I have observed the feature under consideration.

Rh. adenogynum, Diels, supplies one of the most striking examples of these juvenile stages. The red glandular undersurface of the young leaves is most conspicuous. The redness disappears entirely in the leaves of about the third year, which are quite green below and do not form glands or hairs save perhaps a few sebaceous flocks on the midrib. Then after some seven years the buff-coloured tomentum, composed of dendriform long hairs with interwoven branches, begins to show at the base of the leaf. No one would suppose the young plant in these early stages of its life was really *Rh. adenogynum*. Another interesting point may be noted. This species branches from the base of the stem at a very early period

and the first leaves of the branchlets at ground surface have the underside red.

Rh. arboreum, Wall. and its Chinese representative *Rh. Delavayi*, Franch. show the reddening of the juvenile leaf-undersurface and then pass through a green stage. When the indumentum begins to develop it appears along the midrib and spreads out along the primary veins, but does not at first reach the leaf-margin, so that the leaf has a green border around the median grey-coloured indumentum.

Rh. argenteum, Hook. f. has a deep purple glandular undersurface to the early juvenile leaves. Most commonly in the seedlings which I have seen the following leaves are green underneath before development of those with characteristic tomentose indumentum of adpressed rosettes of vesicular hairs appearing simultaneously over the whole surface. In some, however, the red surface remains and the indumentum appears in a blotched fashion upon the surface.

Rh. bullatum, Franch. begins with leaves showing an intensely red undersurface which is also lepidote, with yellowish peltate discontiguous scales, and has a few straight hair-bristles. By the sixth year the red surface appears less conspicuous, being covered by a dense tomentum of amber-brown interwoven hairs which conceals the peltate scales.

Rh. campanulatum, Wall. supplies a typical example of the red glandular undersurface of the juvenile leaf, and the tomentum appears simultaneously over the whole surface, usually in the leaves of about the third year. But I have seen some leaves with blotched indumentum and some in an intermediate stage with a nearly green undersurface.

Rh. Clementinae, G. Forrest is a striking species in the adult state, with its thick white indumentum on the leaf-undersurface. Three-year-old seedlings show no trace of it, and the leaves still have an intensely red undersurface with glands and a few hair-flocks on midrib and at margin. Later stages I do not know.

Rh. dichroanthum, Diels.—Here the juvenile underleaf-surface is deep red.

Rh. Falconeri, Hook. f.—The transition to the adult chalice-hair of the superstratum of the indumentum appears to be early, and is often abrupt, but beautiful blotched states often are seen.

Rh. fictolacteum, Balf. f. has leaves with red and glandular undersurface until its third year, at which stage apparently all the leaves develop the characteristic buff tomentum.

Rh. haematodes, Franch., in which the adult leaves show a dense tawny tomentum, has the juvenile leaf black-purple and glandular beneath.

Rh. Hodgsoni, Hook. f.—The seedlings which I have seen pass through a stage in which the underleaf surface loses much of its red colour, without, however, becoming actually green, before the characteristic tomentum appears.

Rh. lacteum, Franch. shows leaves with green undersurface between the early ones, which have particularly intense red and glandular surface, and the mature leaves with dark tawny somewhat velvety tomentum of stalked rosette hairs. The same transition seems to characterise other species of its series, for instance, *Rh. Beesianum*, Diels, *Rh. fulvum*, Balf. f. et W. W. Sm., *Rh. Traillianum*, G. Forrest.

Rh. niphargum, Balf. f. et W. W. Sm. has a snow-white bistrate indumentum on the undersurface of the old leaves. The juvenile ones are brilliant scarlet beneath, coated with glands secreting a very viscid mucilage. What form the transition to the tomentose condition takes I do not know. Our seedlings three years old show only a slight lessening in intensity of the redness, but no development of indumentum.

Rh. Roxieanum, G. Forrest.—The juvenile leaves are not very glandular on the deep red undersurface, and evidently pass through a green stage before developing indumentum, which has not yet appeared on our three-year-old seedlings.

Rh. sinogrande, Balf. f. et W. W. Sm. shows states resembling those of *Rh. argenteum*, Wall.

Rh. taliense, Franch. has juvenile leaves which appear to pass always through a stage of gradual lessening of redness on the underside without becoming really green, but none of our seedlings, now some six or seven years

old, show as yet any of the thick buff indumentum of the adult.

The illustrations I have named show that the development of anthocyanin pigment in the leaves of the juvenile state is associated with varied forms of hairy indumentum in the leaves of the adult. The history of the transition in the several species remains to be traced. In many species scattered sebaceous floccose hairs appear on the veins before the coating becomes a true tomentum. I may add that in *Rh. Anthopogon*, David Don, in which the adult leaves have a lepidote indumentum, there is reddening of the undersurface in the juvenile leaves.

The facts suggest that there is here a change of construction in relation to a change in climatic relation. The plantlet passes from a position in which its functioning foliage is subject to all the conditions of light, moisture, heat, and air-current, belonging to a stratum at the soil-surface, to one some distance above the soil-surface, in which the same external influencing factors operate in different co-ordination and intensity. Temperature and speeding up of metabolism are prime considerations in the one environment, control of transpiration in the other. The anthocyanin development is an adaptation to the former, the indumentum to the latter. Material devoted to the making of relatively unstable cell-pigments in the early phases of ontogeny is now used for the building of tissues—what a complex laboratory it is!—and perhaps there is special significance in the fact of the indumentum-formation so often beginning at and about the midrib and leaf-base. It certainly secures first attention to the formation of the indumentum hairs.

This anthocyanin formation on the undersurface of leaves is not unknown elsewhere. Text-books record it particularly in plants of woods and like-shaded areas, and observers have pointed out that the coloration is rare in plants which are woolly or have otherwise constructed hair-coverings. Here, in those Rhododendron seedlings, we have the states combined, and the seedlings appear to offer particularly favourable objects for experimental work bearing upon the functions performed by anthocyanin pigments.

Botanists are far from agreed upon this subject of anthocyanin, and conclusions based upon the same set of experiments are sometimes diametrically opposed. In part the conflict of opinion seems to be due to the tendency of workers to see in one activity the only significance of the pigment. As I read the facts of distribution of anthocyanin in Nature, and those of experimental work, I receive the impression that these pigments, having a definite absorptive relation to light and to heat—whatever else they may do,—may operate differently in accordance with the position in which they occur.

Their occurrence in the young unfolding leaves of the bud, particularly in tropical and warm-country trees, is the starting-point for the suggestion of their use as a screen to the chloroplasts against intense insolation; and if to the chloroplasts also to the cytoplasm, whether chloroplasts be present in an organ or are absent, as in the case of the anther. Much experimental work has been carried out to test this hypothesis, which I believe is well founded. It is obviously difficult to apply this interpretation to our Rhododendron seedlings where the pigments are on the under and concealed surface of the leaves, which are not in danger of intense insolation.

The frequent abundance of anthocyanin pigments on leaf-petioles, on stems, on veins, has been advanced in support of the suggestion that they have relation to transport of plastic material; their activity would be that of protecting enzymes from harmful solar rays, and thus aiding metabolism and food-transference. This view is, after all, complementary of the other. There is nothing antagonistic. A screen to the cytoplasm itself against intensity of light rays may well be one also to its products against rays of particular quality. In the case of our Rhododendron seedlings such activity of the pigments in relation to the limited amount of light reaching the leaves is quite possible.

Then there is the heat-relation of the pigments. That a light-relation is not the only one is clearly shown by their presence at the root-tips deep in the soil of so many peat plants. Are they not to be regarded as heat-regulators within the plant? Such a conception by no means negates

the light-screen hypothesis. The two activities are not incompatible. Experiment has shown that reddened leaves have a higher temperature than green leaves. This surely means greater protoplasmic activity in all directions; and whilst to some observers the promotion of transpiration is the primary value to the plant of a heat-relation, to others it is the increased metabolism itself. Is there any reason for disallowing either effect at the several times which favour the respective functions? On the other hand, to some observers the heat-relation of the anthocyanin is solely that of a heat-screen.

The circumstances of our Rhododendron seedlings seem to point to this heat-activity of anthocyanin as important in their case, for light-poverty and radiation-cold are factors not conducive to copious food-formation, and the profuse root-system and large hydathodes of the seedlings suggest a very free water-current. Heat-accession through anthocyanin may well be an aid here.

Not all Rhododendron seedlings show the red pigmentation of the undersurface in juvenile leaves. *Rh. auriculatum*, Franch. is a species in which the adult leaves have a loose underleaf tomentum, and I do not find in the juvenile leaves the red coloration. In species, too, like *Rh. glaucum*, Hook. f., *Rh. hippophaeoides*, Balf. f. et W. W. Sm., *Rh. oleifolium*, Franch., and others, where the adult leaves are lepidote and covered beneath by a wax coating giving them a white or bright grey colour, I have not seen the pigmentation—the leaves have a wax coating through the juvenile life of the plant.

On the other hand, the anthocyanin appears in juvenile leaves of species which do not develop on the leaves of the adult any marked indumentum. Species of the Thomsoni Series—using that term comprehensively to include the Campylocarpum Series and the Selense Series—show this markedly. In them there is a well-developed layer of epidermal papillae forming wax.

These variations point to the value of the seedlings of Rhododendron for a comparative physiological investigation which I believe would throw much light upon the much-discussed problem—the uses of anthocyanin pigments.[1]

[1] See Wheldale, The Anthocyanin Pigments of Plants.

BULBOPHYLLUM IMOGENIAE: A NEW ORCHID FROM NIGERIA. By KENNETH HAMILTON.

(Read 8th February 1917.)

The following is a short note on two orchids collected by me in Nigeria which were forwarded to the Royal Botanic Garden, Edinburgh, and flowered there. Both have proved to be new. The first, *Polystachya Hamiltonii*, W. W. Sm., was described in 1915, but I give below a more precise record of the locality. Of the second a description is given below. Types of both species are preserved in the Herbarium of the Royal Botanic Garden, Edinburgh.

Bulbophyllum Imogeniae, K. Ham. Sp. nov.

Species affinis *B. recurvo*, Lindl., *B. viridi*, Rolfe, et *B. Winkleri*, Schltr.; inflorescentia 1 cm. paulo superante oblongo-globosa densiflora, sepalibus ± 4 mm. longis parte superiore roseo-suffusis inter alia conspicua; flores majores quam ei *B. Winkleri*, quod ex descriptione proximum esse videtur.

Planta epiphytica; rhizoma teres glabrum pseudobulbis approximatis obsessum; pseudobulbi ovoidei compressiusculi obscure quadrangulati usque ad 3 cm. longi, 2–2·5 cm. lati, unifoliati, raro bifoliati. Folia 5–10 cm. longa, 1–2 cm. lata, patentia, oblongo-lanceolata acuta, basi cuneata vel subrotundata, coriacea glabra. Pedunculi deflexi 2–4 cm. longi (in planta duos annos culta) medio bractea lata ornati; inflorescentia 1 cm. paulo superans, ± 1 cm. lata oblongo-globosa densiflora; bracteae patentes oblanceolatae vel obovatae translucenti-membranaceae 2–3 mm. longae. Flores parvuli. Sepala aequilonga minute apiculata circ. 4 mm. longa carnosula glabra infra albido-membranacea supra roseo-suffusa; intermedium triangulari-lanceolatum, lateralia valde obliqua falcata, basi margine anteriore dilatata connata. Petala sepalis ± duplo breviora oblonga obtusa vix vel brevissime apiculata tenuiter membranacea integra glabra. Labellum curvatum linguiforme obtusum carnosulum ± 1·5 mm. longum purpureum marginibus minute purpureo-pilosulum. Columna brevis brachiis

lineari-falcatis acutis. Anthera cucullata glabra; ovarium vix pedicellatum glabrum ± 2 mm. longum.

Nigeria:—In the valleys of the mountains north of the Katsena River, North Nigeria, approx. lat. 7° N., long. 10° E. Collected in 1913 and flowered in the Royal Botanic Garden, Edinburgh, October 1915. The small flowers have the sepals tinted a beautiful rose and are themselves in a compact subglobular spike not unlike that of certain Polygonums. The affinity seems to be near *B. recurvum*, Lindl. (Bot. Reg. 963, under *Tribrachia pendula*) and near *B. Winkleri*, Schltr. from the Cameroons. The specific name is in honour of Miss Imogen Ramsay of Bamff.

The locality of *Polystachya Hamiltonii*, W. W. Sm. (Notes R.B.G. Edin., viii (1915), 347), which was stated somewhat indefinitely at the time of the description, is approximately lat. 7° 25′ N., long. 8° 30′ E., in the valley of the Benue River. This orchid has an inflorescence somewhat more branched and certainly with more flowers than indicated in the original diagnosis.

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

VOLUME XXVII.

PART III.

SESSION 1917–18.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY BY
NEILL & CO., LIMITED.

And to be obtained from the SECRETARY OF THE SOCIETY, *at the Royal Botanic Garden.*

1918.

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TRANSACTIONS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXII.

Some New Species of Primula which have Flowered Recently. By Professor Bayley Balfour, F.R.S.

(Read 13th December 1917.)

The species described here are:—

P. chrysopa, Balf. f. et Forrest.	Yunnan. (Forrest.)
P. Harroviana, Balf. f. et Cooper.	Bhutan. (Cooper.)
P. Hopeana, Balf. f. et Cooper.	Bhutan. (Cooper.)
P. Maclareni, Balf. f.	Korea. (Maclaren.)
P. rupestris, Balf. f. et Farrer.	Kansu. (Farrer and Purdom.)
P. scopulorum, Balf. f. et Farrer.	Kansu. (Farrer and Purdom.)

Primula chrysopa, Balf. f. et Forrest.[1]

A tufted marsh-loving perennial more or less whitely mealy with a slender rootstock rooting freely and emitting many short stolons. Leaves with long petioles as much as 13 cm. long, ascending; lamina somewhat fleshy concave in the middle above recurving at the sides oblong-elliptic or sometimes elliptic as much as 3 cm. long and 1·5 cm.

[1] *Primula chrysopa*, Balf. f. et Forrest.—Caespitosa plus minusve albo-farinosa stolones breves emittens. Folia longe petiolata ad 13 cm. longa ascendentia; lamina oblongo-elliptica circ. 3 cm. longa 1·5 cm. lata circumcirca dentata margine minute glanduloso-ciliata in petiolum abrupte cuneatim contracta utrinque pilis fariniferis pulverulenta. Scapus ad 25 cm. altus cum bracteis pedicellisque albo-farinosus umbellam 2–4-floram solitariam gerens nunc verticillo infra praeditus. Flores fragrantes nutantes. Calyx late fusiformis angulatus, lobis conniventibus. Corolla pallide lilacina aureo-oculata extus albo-farinosa ore strumis cincta, lobis latis obcordatis imbricatis bifidis. Stamina floris brevistyli ad os corollinum inserta. Stylus brevis calyce paullo longior. Species *P. gemmiferae*, Batal. affinis foliis longius petiolatis albo-farinosis, corolla extus albo-farinosa inter notas alias distinguenda.

broad, dentate all round, the teeth often denticulate ending in a horny hydathode and most minutely gland-ciliate, base more or less wedge-shaped and abruptly contracted into the long petiole, upper surface bright green smooth the mid-rib conspicuously grooved primary veins few sunk in the lamina ascending, under surface pale green the mid-rib whitish and with primary veins prominent, on both surfaces powdered with stalked meal-forming glands; petiole as much as 10 cm. long narrow scarcely winged slightly expanded at base clad with meal-forming glands. Scape as much as 25 cm. high (lengthening somewhat in fruit) slender and like the bracts and pedicels coated with white meal, bearing a terminal 2–4-flowered umbel and sometimes a 2–4-flowered whorl below it; bracts erect adpressed about 5 mm. long green or purpling involucrate oblong narrowed to the obtuse apex slightly keeled, at the base slightly thickened not spurred; pedicels varying in length longest as much as 4 cm. long, those of the lower whorl shortest, straight and erect below nodding at the top; anthopode about 1 mm. long white farinose. Flowers fragrant. Calyx green or more or less purple as much as 5 mm. long whitely mealy both outside and inside broadly fusiform 5-grooved split to the middle into 5 connivent lobes. Corolla pale lilac with golden eye, oblique, expanded vertically: tube of the short-styled flower about 1·5 cm. long straw-coloured cylindric, swollen and deeper coloured above the insertion of stamens, more or less mealy outside, rugulose inside, at the throat encircled by orange-coloured puberulous pouchings (as many as 15) which hardly form an annulus; limb somewhat reflexed with a disk about 1·5 mm. broad and 5 broad obcordate imbricate bifid lobes about 6 mm. long more or less crenulate, puberulous towards the base above, more or less farinose beneath. Stamens in short-styled flower inserted close to mouth of corolla-tube; filaments conspicuous not expanded at base straw-coloured; anthers about 2 mm. long not crested but with slightly hairy whitish connective, scarcely protruding from corolla-tube. Ovary broadly globose green; short style pale green longer than the calyx; stigma green capitate and depressed. Capsule cylindric about 1 cm. long and 3 mm. in diameter without a stylopod, lower part included in calyx, crustaceous

upper part naked thickened and dehiscing from its top to the mouth of the calyx-tube by 5 short valves; placenta cylindric about 4 mm. long with a stout stalk about 1 mm. long. Seeds pale tawny oblong flattened, the testa minutely tuberculate winged all round by a many-celled membranous aril, 0·75 mm. long, with the aril 1·5 mm. long.

E.N.E. Yunnan:—Bei-ma-shan. Mekong-Yangtze divide. Alt. 14,500 ft. Lat. 28° 20′ N. Plant of 6–12 ins. In fruit. Stony moist alpine pasture. G. Forrest. No. 13,231. August 1914.

This is a pretty oblique-flowered species. In habit it is like *P. Wardii*, Balf. f., but without alliance with that species, having white meal and no spurs to the bracts. It is really very near *P. gemmifera*, Batal., but the leaves have much longer petioles and a relatively shorter blade with deeper and larger teeth than in that species, and are always dusted with meal, as is the outside of the corolla. Then the flowers have a delicious fragrance, and the contrast between the orange-coloured eye and the pale lilac or violet petals is very pleasing.

The plant is very different from *P. sibirica*, Jacq., which has spurs to the bracts as in *P. involucrata*, Wall. and in *P. Wardii*, Balf. f.

Plants raised from seed collected by Mr. Forrest have flowered with Messrs. Wallace at Colchester and also at Edinburgh in 1916. It is a free grower, after the fashion of *P. conspersa*, Balf. f. et Purdom and *P. Wardii*, Balf. f., and produces abundant lateral shoots which grow out as short stolons so that it quickly covers the soil. We have not yet at Edinburgh grown it in the open, but I expect it will be as hardy as *P. Wardii*, Balf. f. Like all mealy Primulas which depend upon the meal for their effect it may not be in the open so beautiful a plant as it is when grown under cover owing to the loss of meal under rain.

Primula Harroviana, Balf. f. et Cooper.[1]

A perennial small rosulate herb, the leaves and flowers coaetaneous. Leaves petiolate small at flowering period

[1] *Primula Harroviana*, Balf. f. et Cooper.—Rosulata rhizomate parvo foliis floribusque coaetaneis. Folia petiolata sub anthesi parva ad 5 cm. longa (sub fructu ad 11 cm. aucta); lamina elliptica vel oblongo-elliptica vel oblonga nunc ovata circ. 2·5 cm. longa ad 2 cm. lata apice

as much as 5 cm. long increasing to about 11 cm.: blade elliptic or oblong-elliptic or oblong sometimes ovate as much as 2·5 cm. long by 2 cm. broad at flowering time, rounded at apex, margin shortly lobulate with obtuse or somewhat truncate and denticulate lobules the teeth glandular and ending in a horny hydathode, green on both surfaces and concolorous, abruptly contracted into a conspicuous slightly winged equally long or slightly shorter petiole with a short open vagina; upper surface convex rugulose shining and punctulate (not viscid) with capitate stalked uncoloured potentially mealy glands; under surface reticulately alveolar clad with glands like upper surface but more densely. Scape as much as 8 cm. high (in fruit increasing to 12 cm.), 2 mm. in diameter, white-mealy, crowned by a many-flowered somewhat spicate capitulum; bracts small inconspicuous, lowermost about 5 mm. long lanceolate from the base, acuminate glabrous membranous, white with a green tip, hidden by the de-

rotundata margine breviter lobulata lobulis obtusis vel subtruncatis et denticulatis utrinque viridis concolor, supra convexa rugulosa glandulis capitatis stipitatis albidis farini-potentibus nitenti-punctulata haud viscida, subtus reticulatim alveolata glandulis ut supra densius vestita, in petiolum conspicuum leviter alatum aequilongum vel paullo breviorem subito contracta petioli vagina brevi aperta. Scapus ad 8 cm. (sub fructu 12 cm.) altus 2 mm. diam. albo-farinosus capitulum multiflorum subspicatum gerens; bracteae parvae inconspicuae infimae 5 mm. longae floribus deflexis occultae a basi lanceolatae acuminatae supremae virides inter flores vix conspicuae. Calyx laete viridis deflexus obliquus tenuis tubum corollinum subaequans, tubo subventricoso postice convexo extus intusque plus minusve farinoso, lobis 5 tubum subaequantibus inaequalibus saepe inter se plus minusve conjunctis extus intusque glabris lobo postico maximo subquadrato lato vertice subtruncato et fimbriato glanduloso-ciliato decurvato (sed fimbriis apicalibus plerumque adscendentibus) antero-lateralibus minoribus saepe oblongis angustis ad apicem obtusis. Corollae eburneae infundibuliformis extus ex toto farinosae tubus cylindricus angustus tenuis circ. 7–8 mm. longus supra stamina paullo ampliatus exannulatus, limbus late ampliatus profunde concavus farinosus 5-lobatus, lobi circ. 3·5 mm. longi subtruncati bifidi segmentis approximatis et fimbriatis. Staminum filamenta brevia in flore brevistylo ad os corollinum inserta in flore longistylo infra medium tubi inserta. Ovarium globosum; stylus brevis vix 1 mm. longus, longus tubum corollinum aequans; stigma discoideum depressum flavido-album. Capsula globosa circ. 2·5 mm. diam. calyce aucto albo-farinoso inclusa in dimidio superiore crustacea infra membranacea valvis 5 ab apice ad medium dehiscens; semina complanata ovalia disciformia circ. 1·5 mm. longa pallide brunnea, testa papillata.

Species bene distincta in sectione Muscarioide, inter notas alias corolla eburnea, calyce laete viridi, corollae farinoso-glandulosae tubo longo angusto.

flexed flowers, upper ones green inconspicuous amongst the flowers; pedicels none; anthopodium hardly developed. Calyx bright green deflexed oblique thin equalling in length corolla-tube; tube 7 to 8 mm. long subventricose, posteriorly convex, both outside and inside white-mealy; lobes 5 equalling the tube glabrous outside and inside, unequal, posterior largest subquadrate often 2·5 mm. broad subtruncate at top and fimbriate glandular-ciliate decurved the fringe upturned, postero-lateral lobes like to but narrower than posterior, antero-lateral lobes smallest often oblong narrow and obtuse at apex, some lobes often confluent, posterior lobe including others in bud. Corolla ivory-white everywhere white-mealy outside, about 1·6 cm. long in short-styled flower, about 1·4 cm. long in long-styled; tube narrow about 1·25 mm. in diameter in short-styled flower, 2 mm. in long-styled, cylindric slender somewhat rugulose and shining inside, mealy above the stamens, in short-styled flower about 8 mm. long, in long-styled about 7 mm., slightly ampliate above the stamens, exannulate; limb widely ampliate deeply concave potentially mealy inside; lobes about 3·5 mm. long, subtruncate bifid the segments connivent and subfimbriate. Stamens with very short filaments slightly expanded at base, in short-styled flower inserted at mouth of corolla, in long-styled below middle of corolla-tube with anther-tips about 4 mm. from its mouth; anthers pale yellow with paler connective. Ovary globose with thin pale wall about 1·5 mm. in diameter; short style pale yellow scarcely 1 mm. long, long style reaching mouth of corolla-tube; stigma large yellowish-white discoid recurved depressed. Capsule pale brown, about 2·5 mm. in diameter crustaceous in upper half, without stylopod, membranous in lower half and there enclosed in the slightly enlarged mealy calyx, dehiscing to middle by 5 valves; placenta stipitate the stalk about 0·5 mm. long, ovuliferous area conoid 1 mm. in diameter wider than the stalk and reaching top of capsule. Seeds flattened oval disk-like about 1·5 mm. long, pale brown, testa papillate.

Bhutan. Cooper. No. 4975.

A charming white-flowered species of the Muscarioid section of Primula which flowered in the Royal Botanic

Garden, Edinburgh, in 1917. The plant was raised from seed derived from a dried specimen collected by Mr. Roland E. Cooper when exploring in Bhutan for Bees Ltd. Mr. Cooper's specimen bore no flowers. I have not yet seen enough of the species to enable me to say whether the capitate glands which occur all over the leaves and are undoubtedly potential farina-formers usually reach the stage of producing it. The scape and the flower are farinose.

In some ways *P. Harrowiana*, like *P. nutans*, suggests the Soldanelloid section, approaching it in the relatively large ampliate limb of the corolla and the very narrow tube, in the farinose glands on the corolla, and in the fimbriate truncate corolla-lobes. But its inflorescence and calyx are essentially Muscarioid.

Only experience will tell us whether it is to be hardy or not. Named after Robert Lewis Harrow, Principal Gardener of the Royal Botanic Garden, Edinburgh.

Primula Hopeana, Balf. f. et Cooper.[1]

A tufted herb with the short hard rhizome and fibrous roots of *P. sikkimensis*, Hook., epilose. Leaves long narrow as much as 14 cm. long, 2 cm. broad; lamina chartaceous elongated oblong or oblanceolate, rounded at apex, margin erose dentate, teeth ending in a conspicuous

[1] *Primula Hopeana*, Balf. f. et Cooper.—Herba caespitosa *P. sikkimensi*, Hook. affinis. Folia angusta ad 14 cm. longa ad 2 cm. lata; lamina efarinosa elongata oblonga vel oblanceolata margine eroso-dentata deorsum in petiolum basi erubescentem anguste alatum lamina dimidio longiorem gradatim angustata, supra atro-viridis subtus pallidior utrinque glandulis brevibus capitatis farini-potentibus praedita. Scapus ad 30 cm. altus cum bracteis pedicellisque lacteo-farinosus umbellam 3–6-floram gerens; bracteae brunneo-purpureae lineares acuminatae circ. 8 mm. longae; pedicelli virides nutantes circ. 1·5 cm. longi (sub fructu aucti ad 9 cm.). Calyx angustus fusiformis 5-angulatus tubum corollinum subaequans dense farinosus fere ad basim 5-fissus lobis lanceolatis acutis intus apice farinosis. Corolla lacteo-alba extus glabra tubo cylindrico exannulato, limbo tubo paullo longiore infundibuliformi intus farinoso, lobis rotundatis circ. 5 mm. diam. emarginatis. Stamina in flore longistylo tubi corollini basim versus inserta, filamentis conspicuis, antheris flavis angustis oblongis circ. 1·5 mm. longis apiculatis. Ovarium turbinatum: stylus longus exsertus; stigma flavidum depressum discoideum revolutum. Capsula basi calyce inclusa valvis 5 bidentatis ab apice ad medium dehiscens; placenta stipitata cylindrica; semina laevia magna complanata.

Species sectionis Sikkimensis foliorum capsulaeque magnitudine et floribus lacteo-albis distincta.

hydathode, tapered downwards into a long narrowly winged shining petiole half again as long as lamina without a vagina and often reddened at base, upper surface dark green, under surface paler, the midrib broad concave above, very prominent beneath, primary veins conspicuous below; upper surface sprinkled lower surface more thickly covered with nearly sessile capitate potentially mealy glands. Scape slender as much as 30 cm. high mealy with creamy-white meal as are the bracts and pedicels, bearing a solitary terminal umbel 3–6-flowered; bracts linear acuminate one-nerved about 8 mm. long 0·75 mm. broad, brown purple; pedicels drooping fragile about 1·5 cm. long (elongating to 9 cm. in fruit) green, anthopode top-shaped at least 1 mm. long. Calyx narrow fusiform about 7 mm. long almost equalling corolla-tube 5-angled brown purple densely mealy outside, cut almost to base into 5 lanceolate acute keeled adpressed lobes without conspicuous hydathode sprinkled with meal inside at the top. Corolla cream-white glabrous outside; tube cylindric smooth within, exannulate, about 8 mm. long in long-styled flower tinted sometimes greenish or pink, expanding into a 5-lobed funnel-shaped limb about 1 cm. long densely mealy inside; lobes rounded with smooth edge emarginate about 5 mm. long and broad. Stamens in long-styled flower inserted about 1·75 mm. from base of corolla-tube, filaments greenish expanded at base slightly shorter than narrow oblong yellow anther which is about 1·5 mm. long with greenish connective and short apiculus. Ovary somewhat top-shaped; long style slightly exserted pale green; stigma large tinted yellow discoid depressed slightly revolute. Capsule cylindric about 9 mm. long about 3 mm. in diameter, in lower two-thirds enclosed by calyx, crustaceous where exposed membranous within calyx, chestnut-brown glistening, dehiscing from the apex by 5 valves each usually splitting into 2 teeth; placenta cylindric with short stipe 1·25 mm. long, placentiferous area about 7·5 mm. long; seeds large flattened about 2 mm. long by 1·5 mm. in diameter often curved round the placenta, smooth, obscurely squamous on surface, amber-coloured.

Bhutan. Ridge S.E. of Angduphorang. Alt. 13,500 ft.

Among boulders in sandy peat turf by streams. R. E. Cooper. No. 4807. 16th September 1915.

A beautiful new species of the Sikkimensis series—fragrant as members of the series are. Its creamy-white flowers, short capsules, and shorter and narrower leaves distinguish it from others of the series. From seeds collected by Mr. Cooper for Mr. Bulley—some of which were generously presented by Mr. Bulley to the Royal Botanic Garden, Edinburgh—plants have been raised and flowered by Mr. Bulley and also at Edinburgh in 1917. It is a free-growing plant, not so large or so floriferous as *P. sikkimensis*, and I see no reason to doubt that it will prove as hardy as is that species.

The plant is named after Joseph Hope, gardener to Mr. Bulley at Ness, Neston, Cheshire, to whose skill is due the raising of the plants from seeds collected by Mr. Cooper in Bhutan.

Primula Maclareni, Balf. f.[1]

A multicipital herb the leaves deciduous annually from the somewhat elongated underground rhizome. Rhizome producing ovoid perennating chamber-buds covered by a few red-brown membranous cucullate scales. Leaves erect long-petiolate as much as 37 cm. long (Maclaren); lamina of reniform or nearly orbicular outline about 8 cm. in transverse diameter with 7–9 divergent primary veins,

[1] *Primula Maclareni*, Balf. f.—Herba multiceps gemmis globosis magnis perennans rhizomate elongato foliis mox deciduis. Folia elata erecta longe petiolata ad 37 cm. longa; lamina ambitu reniformis vel suborbicularis multi-lobata lobis triangularibus acutis dentatis glanduloso-pilosa margine glanduloso-ciliata basi cordata. Scapus ad 7 dm. longus, cum bracteis pedicellisque calyceque glanduloso-pubescens vel puberulus umbellam terminalem et verticillos 2–3 ad 8-floros gerens; bracteae lineari-subulatae virides circ. 4 mm. longae pedicellis breviores; pedicelli breves circ. 6 mm. longi virides nutantes. Calyx viridis campanulatus circ. 8 mm. longus fere ad basim 5-lobatus lobis lanceolatis uninerviis sinubus membranaceis, hydathodeo conspicuo terminatis. Corolla atro-kermesina viridi- vel flavido-oculata, tubo in flore longistylo circ. 1 cm. longo in brevistylo 1·2 cm., extus glanduloso-puberulo, annulato, limbi plani disco circ. 2 mm. lato minute glanduloso-puberulo, lobis 5 obcordatis vel cuneatis bifidis. Stamina in flore brevistylo ad os tubi corollini inserta in flore longistylo basim versus inserta, filamentis conspicuis, antheris luteis connectivo lacteo-albo. Ovarium turbinatum; stylus brevis calyce brevior, longus paullo exsertus; stigma discoideum viride.

Species in sectionem Geranioides ponenda et magnitudine atque inflorescentia candelabroidea distinguenda.

shallowly 7–9 lobed, lobes triangular acute more or less dentate, lobes and teeth ending in a prominent hydathode often 1 mm. long, margin ciliate with glandular hairs, base cordate with an open or closed sinus, upper surface bright green, lower paler both glandular-hairy; petiole about 9 cm. long green glandular hairy. Scape about 5–7 dm. long (Maclaren) far exceeding the leaves, green glandular-pubescent as are the bracts and pedicels and outside of calyx, bearing 2–3 whorls and a terminal umbel of 6–8 flowers each; bracts linear-subulate about 4 mm. long, green; pedicels short about 6 mm. long drooping, green; anthopode narrow. Calyx campanulate green about 8 mm. long glabrous inside, cut to near the base into 5 lanceolate patent divaricate one-nerved lobes, nerve inconspicuous and ending in a large pale yellow green hydathode, sinuses membranous. Corolla crimson-lake (in bud deep plum-purple) with yellow-green or yellow-tinted eye; tube tinted red outside, cylindric below the stamens, ampliate above them, glandular-puberulous outside, more or less transversely rugose, in long-styled flower about 1 cm. long in short-styled about 1·2 cm., annulate, annulus of ten lobes antipetalous in pairs; limb flat, disk about 2 mm. broad shortly gland-puberulous olive-green or tinted yellow and bounded by a narrow deep-magenta ring; lobes 5 obcordate or cuneate about 8 mm. long and broad, deeply bifid, segments divaricate often lobed and with an apiculus in the sinus. Stamens in long-styled flower inserted about 4 mm. from base of corolla-tube, in short-styled near the top the anthers reaching the annulus; filaments stout conspicuous nearly as long as the anther; anther ovate apiculate yellow with cream-white connective about 1·25 mm. long. Ovary smooth turbinate; long style slightly exserted, short style shorter than calyx; stigma discoid green.

Central Korea. Province of Whanghaido. Flowering June 1915. Growing in rank grass at bottom of a narrow valley at 4000 ft. Uncommon. Only seen in one group. Mr. Malcolm Maclaren—after whom the plant is named.

A tall-growing species of the Geranioid section, differing from all other described members of the section by its tiered candelabra inflorescence reaching over 7 decimeters

in height, giving it the appearance, as Mr. Maclaren its discoverer remarks, of *P. japonica*. *Rh. septemloba*, Franch. sometimes but seldom shows one whorl below the terminal umbel. There is, however, a Yunnan plant of the section rivalling *P. Maclarenii* in the size of the scape and number of tiers of flowers. It was found in 1913 by Mr. Forrest on the Chungtien Plateau at 10,000 ft., and he speaks of it as a plant of 2½ ft. high. The dried specimens in Mr. Forrest's collection are in fruit only, and whilst I have no doubt about it being a new species as yet undescribed, I have not felt warranted up till now in describing it in the absence of flowers.

Seeds of the Korean plant were presented to the Royal Botanic Garden, Edinburgh, by Mr. P. D. Williams, of Lanarth, Cornwall, and seedlings raised from them flowered in 1917. The plant has not yet been grown in the open and has not attained its maximum size. The longest scapes on our plants were about 18 ins., and they produced three whorls of flowers below the terminal umbel.

The plant loses its foliage after flowering, like *P. jesoana*, Miq. of the same section, and perennates like it by the formation of numerous ovoid or globose buds on the rhizomes. These buds look like bulbils, but they have no fleshy scales and are really chamber-buds, that is to say, each is composed of a number of membranous scale-leaves, the outer brown closely enrolling the inner green ones and forming a chamber in which are found the already formed young leaves and the incipient flower-shoot of the next season standing on a broad flattened axis and not overlapping nor filling up the chamber. The scale-leaves are viscid, the secretion acting as in other cases as a protection to the young soft parts within.

Primula rupestris, Balf. f. et Farrer.[1]

A sticky perennial herb coated everywhere with long and short glandular hairs. Leaves as much as 13 cm. long

[1] *Primula rupestris*, Balf. f. et Farrer.—Herba multiceps. Folia longe petiolata ad 13 cm. longa viscida glanduloso-pilosa pilis brevibus et longis intermixtis; lamina elliptico-ovata ad 4 cm. longa et lata fere rotundata margine plerumque 7-lobata lobis inaequaliter lobulatis lobulis obtusis vel rotundatis vel subtruncatis ad apicem rubro-punctatis basi cordatis sinu clauso, supra convexa atro-viridis opaca,

with long petioles; lamina elliptic-ovate or almost rounded as much as 4 cm. long and broad, rounded at apex, usually 7-lobed the lobes unequally lobulate each lobule obtuse rounded or somewhat truncate its mid-vein ending in a red point, base cordate with usually a closed sinus, upper surface opaque dark green convex, under surface more or less red prominently venulose; petiole much longer than lamina about 9 cm. long red, terete but for a slightly grooved upper surface, swollen at very base into a vaginal cushion. Scape as much as 15 cm. high bearing a terminal umbel and one or two lower whorls of flowers usually about 5–6 in a whorl or umbel; bracts linear acute about 1 cm. long and 1 mm. broad, green with a red vagina; pedicels unequal 2–4 cm. long spreading red, attached to centre of slightly hollowed broad base of calyx. Calyx inversely funnel-shaped about 5–6 mm. long (enlarging in fruit) about half the length of the corolla-tube which is glandular-puberulous outside, inflated at base and there about 5–6 mm. in diameter, narrowed upwards and divided to beyond middle into 5 adpressed elongated triangular obtuse or acute lobes often paler than the green tube. Corolla white, lilac, or rose with a yellow-green eye glandular-puberulous through-

subtus concava plus minusve rubra prominenter venosa; petiolus lamina multo longior ad 9 cm. longus ruber crassus teres sed supra paullo sulcatus basi in vaginam pulvinatam incrassatam expansus. Scapus ad 15 cm. altus umbellam terminalem et verticillos 1–2 ad 6-floros gerens; bracteae lineares acutae circ. 1 cm. longae 1 mm. latae virides basi in vaginam subamplexicaulem pulvinatam expansae; pedicelli in quaque umbella vel verticillo variabiles nunc 4 cm. longi nunc 2 cm. ad centrum fundi calycini intrusum late affixi rubri patentes. Calyx obinfundibuliformis extus intusque glandulosus glandulis stipitatis, basi inflatus ibique circ. 5–6 mm. latus sursum angustatus sub anthesi circ. 5–6 mm. longus (demum auctus) tubo corollino dimidio brevior ultra medium 5-lobatus lobis elongato-triangularibus obtusis ad corollam adpressis tubo viridi pallidioribus. Corollae extus conspersim glandulosae tubus cylindricus supra stamina ampliatus in flore longistylo circ. 1 cm. in flore brevistylo circ. 1·4 cm. longus albidus et flavido-tinctus extus glanduloso-puberulus intus glaber exannulatus fauce circularis, limbi plani patentis discus flavido-viridi-oculatus substrumosus 1·5 mm. latus supra glanduloso-puberulus, lobi 5 obcordati albi vel violacei vel rosei profunde emarginati. Stamina in flore longistylo basim versus in flore brevistylo supra medium tubi corollini antherarum apicibus ab ore 3·5 mm. remotis inserta antheris angustis fere sessilibus circ. 2 mm. longis. Ovarium fere globosum viride; stylus albidus, longus inclusus calycem superans, brevis vix calycem aequans ovario duplo longior; stigma pallide viride capitatum.

Species *P. sinensi*, Lindl. affinis calyce sursum abrupte contracto lobis sepalinis adpressis, corollae limbo minore inter notas alias recognoscenda.

out outside, tube cylindric expanded above stamens, in long-styled flower about 1 cm. long, in short-styled about 1·4 cm. long, about twice the length of calyx, white tinted yellow at top, glabrous inside, exannulate with a circular mouth; disk of the flat spreading limb about 1·5 mm. broad yellow-green glandular-puberulous somewhat strumous at base; lobes 5 obcordate 1 cm. long and broad or more, deeply emarginate minutely papillose above. Stamens in long-styled flower inserted near base of corolla-tube about equalling calyx in short-styled above middle of corolla-tube with anther-apices about 3·5 mm. from its mouth, anthers almost sessile narrow about 2 mm. long. Ovary green nearly globose; style white, long style included in corolla-tube a little longer than calyx, short style scarcely as long as calyx, twice length of ovary; stigma pale green capitate.

Szechwan. "*Primula rupestris* occurs on hard dry reddish limestone cliffs in the Da Ba San (Ta Pa Shan), seen first between Ming Chiang Chow and Tai-an-i, down over the Shensi-Szechwan border, and last seen on a limestone bluff above the Kia Ling Kiang where it debouches into the Red Basin of Szechwan. The journey between Lo-yang and Kwang-Yüen goes each day over a low little wooded range running up to some 8000 ft. The Primula haunts cliff-faces in the gorges, exactly as *P. Allionii* grows in the dry hard cliff-faces of the Roja. Only withered relics were to be seen when I passed through in early November 1915; in fact it was only with much difficulty and after long search that I succeeded in finding a few seeds still lingering. In such conditions it is hardly to be wondered at if I failed to differentiate it from *P. sinensis*, remote though such an extension of distribution would have been. I have no doubt that *P. rupestris* pervades all those small low ranges of the Da Ba San on its limestone outcrops, on the gorge-cliffs, etc., at an elevation of some 6000–7000 ft. Its habits and habitat suggest a great dislike for winter damp, but from its geographical station I hoped it might prove as much hardier than *P. sinensis* as has since been proved to be the case."—R. Farrer.

From seed collected by Mr. Farrer, *P. rupestris* is now in cultivation and flowered in 1916 in the Royal Botanic

Garden, Edinburgh. It is a near ally of the well-known *P. sinensis*, Lindl. of Western Hupeh and Eastern Yunnan, the only species hitherto described of the Auganthus series of Primula. Hardier than its ally, it may prove a valuable addition to the plants of the outdoor garden, especially if it varies as much as *P. sinensis* under cultivation. It differs from the wild plants of *P. sinensis* in its larger leaves with longer and stouter petioles, its longer and stouter pedicels, the calyx abruptly tapering from the swollen base into the elongated triangular adpressed lobes more than half the length of the calyx, the smaller corolla limb. As in *P. sinensis* the corolla is glandular on the outside. I mention this because Pax says the corolla in *P. sinensis* is eglandular.

At the Primula Conference in 1913 I referred to the geographical distribution and the variability of the Chinese species *P. sinensis* and *P. obconica*, Hance, pointing out that whilst the latter is widely spread in Western China and shows many form-modifications in relation to habitat in cultivation, it has not varied or developed to the extent exhibited by *P. sinensis*, which is only known from the one area about Ichang. Here we have now in this Szechwan plant a form-modification of the type of *P. sinensis*, and it may be taken as indicating that there are probably others to be discovered in the wide region that intervenes between W. Hupeh and Kansu. There is another form in cultivation, found by Wilson in W. Szechwan (I believe), but no description of it has yet appeared—a fate that has attended so far many interesting new forms of Primula collected by Wilson, dried specimens of which have been distributed by the Arnold Arboretum.

Primula scopulorum, Balf. f. et Farrer.[1]

A pretty plant coated with yellow meal forming a rosette of nearly prostrate leaves beneath which are the dry

[1] *Primula scopulorum*, Balf. f. et Farrer.—Species parva rosulata foliis prostratis luteo-farinosis. Folia oblonga vel oblongo-ovalia vel oblongo-elliptica irregulariter dentata fere sessilia supra sparsim subtus dense luteo-farinosa. Scapus ad 3 cm. longus cum bracteis pedicellisque luteo-farinosus umbellam ad 13-floram gerens, floribus deinceps evolutis; bracteae ovato-lanceolatae ad 7 mm. longae; pedicelli ad 2 cm. longi. Calyx anguste campanulatus ad 7 mm. longus 5-costatus ad medium 5-lobatus extus intusque luteo-farinosus lobis oblongis vel

withered leaves of previous years. The roots from the small rhizome delicate in relation to the mossy soil of its native habitat. Leaves as much as 4 cm. long and 2 cm. broad oblong or oblong-oval or oblong-elliptic rounded at apex irregularly toothed on margin the teeth ending in conspicuous hydathodes, base more or less narrowed to a hardly distinct petiole, primary veins feathered and ascending, upper surface sparingly lower surface densely coated with yellow meal. Scape short as much as 3 cm. long stoutish and like the bracts and pedicels yellow-mealy, bearing an umbel of as many as 13 flowers which open one or two at a time in succession; bracts ovate oblong-lanceolate keeled and cucullate, as much as 7 mm. long; pedicels stiff stoutish spreading, as much as 2 cm. long; anthopode top-shaped often 1 mm. long. Calyx narrowly campanulate as much as 7 mm. long 5-ribbed, the sinuses not thinner, with yellow meal outside and inside, split to about the middle into 5 oblong or oblong-ovate acute lobes their midrib and lateral ascending veins conspicuous without evident terminal hydathode. Corolla red-violet with yellow eye, coated outside where exposed with yellow meal, somewhat membranous; tube cylindric tinted red, in short-styled flower about 1·4 cm. long, in long-styled about 1·2 cm., transversely rugose the uppermost ridges at the throat swollen into a sort of annulus, disk of the limb yellow about 1·5 mm. broad most minutely puberulous; lobes as much as 1 cm. long and broad imbricate obovate or somewhat obcordate deeply bifid the segments divaricate. Stamens with very short filaments, the anthers about 2·5 mm. long, ochre-coloured with purple connective, in short-styled flower inserted near top of corolla-tube the anther-tip about 1·5 mm. from the mouth, in long-styled flower near base of corolla about equalling the calyx.

oblongo-ovatis acutis. Corolla rubro-violacea luteo-oculata extus luteo-farinosa tubo in flore brevistylo circ. 1·4 cm. longo, in longistylo circ. 1·2 cm., ore strumoso pseudo-annulato, lobis obovatis vel subobcordatis circ. 1 cm. longis bifidis. Stamina in flore brevistylo prope os corollae inserta in longistylo prope basim. Stylus longus inclusus stigmate ab ore corollae circ. 2·5 mm. remoto, brevis calyce paullo brevior; stigma discoideo-capitatum.

Species *P. membranifoliae*, Franch, affinis foliis fere sessilibus, pedicellis calyceque multo brevioribus, corolla efarinosa inter notas alias facile distinguenda.

Ovary with flat summit somewhat top-shaped; style and stigma pale green, long style included, the stigma about 2·5 mm. from corolla mouth, short style slightly shorter than calyx; stigma discoid-capitate.

Kansu. "The specimens show the plant at its best, and are from cool shady moss ledges (10th May) on the limestone at about 6000–8000 ft. in the Satanee Alps. In those of Siku it ascends actually to the summit ridges at 12,000–13,000 ft. (22nd June), but here (I think the northerly limit of its range) it is in all situations and heights much squinnier and poorer in all ways than these fine but typical specimens of the Satanee Alps. (Flowers from April–May, low down, to the end of June on the tops.)" F. 39. P. No. 2. Farrer and Purdom. Coll. 1915.

This species found by Messrs. Farrer and Purdom is now in cultivation from seed collected by them, and it flowered in the Royal Botanic Garden, Edinburgh, in 1916 in a cold pit. It has not been grown outside yet, though it is probably hardy, but covered as it is with yellow meal, easily washed off by rain, it will likely lose much of its effectiveness when grown in the open.

One of the Yunnanensis series of Primula, its nearest ally is the Yunnan *P. membranifolia*, Franch. That species is readily distinguished by the large cushion which it forms, its paler leaves spathulate in form, its thinner scape much shorter pedicels and calyx and by the colour of the corolla and absence of meal on the outside of it.

The flat prostrate rosette of leaves is a conspicuous character of *P. scopulorum*, as is also the long period of flowering. This results from the production of many flowers in the umbel and their unfolding one after the other. One sees the same prolonged flowering in other members of the Yunnanensis series.

Either *P. scopulorum* is a variable plant in Kansu or two species very like one another and growing together have been gathered and treated as one. Messrs. Purdom and Farrer's dried specimens show two forms, and amongst our cultivated plants two forms have appeared. I am not yet prepared to deal with this problem.

(*Issued separately* 29*th December* 1917.)

SOME LATE-FLOWERING GENTIANS.

By Professor BAYLEY BALFOUR, F.R.S.

(Read 14th February 1918.)

There is a small series of Asiatic Gentians belonging to the Section named Frigida by Kusnezow which are the glory of the autumn garden, but which, as introductions of more or less recent years, are not yet known as they ought to be and will be. There is some confusion in their nomenclature, and I shall take the opportunity to clear this up when writing now, as I propose to do, upon the characters and distinctions of the species.

The species to which I refer are four:—

G. Farreri, Balf. f.	Kansu.	Discovered, Farrer and Purdom, 1914. Introd. Farrer, 1914. First flowered, Edinburgh, 1916.
G. Lawrencei, Burkill.	Siberia (Baicalia).	Discovered, Bocherel. Introd. Leichtlin, 1905. First flowered, Sir Trevor Lawrence, 1905.
G. sino-ornata, Balf. f.	Yunnan.	Discovered, Forrest, 1904. Introd. Bulley, 1911. First flowered, Ness and Edinburgh, 1912.
G. Veitchiorum, Hemsley.	Szechwan.	Discovered, Wilson. Introd. Veitch, 1905. First flowered, Veitch, 1905.

They are prostrate forms spreading by stolons — reaching in *G. sino-ornata* some 18–25 cm. in length— from a central rosette. Each stolon prostrate at first ascends as its vegetative growth ceases and ends in a single flower. These stolons may root, and at the point of rooting start a new rosette whence new stolons are emitted. Thus the plant may cover a considerable area in the garden. *G. Veitchiorum* seems to be the least effusive in its extension. The whole of them have paired leaves connate at the base. By this character they are at once separated from another series of the Section Frigida, that of *G. ternifolia*, Franch., *G. tetraphylla*, Franch., *G. hexaphylla*, Franch., and *G. Arethusa*, Burkill, in which there are always more than two leaves in the nodal whorl. In the Ternifolia series occur flowers no less beautiful and late flowering than those of the series of which I am writing,

but only one species—*G. hexaphylla*, Franch.—is in cultivation so far as I know. Introduced by Farrer, it flowered at Edinburgh in August 1916, in plants raised from seed presented by the late Robert Woodward, Esq., jun., of Arley Castle, Bewdley.

In the paired-leaved series of which I write, the leaves of the pair have each the potentiality to produce an axillary shoot, but as so commonly happens in such cases the bud of one of the leaves is prepotent, and the prepotent buds in successive pairs follow a $\frac{1}{4}$ spiral course round the axis which produces them. If a prepotent bud develops a shoot, its sister bud in the opposite leaf-axil is suppressed. but if from any cause the prepotent bud be arrested or destroyed, then the energies of the sister bud are called upon and it may elongate as a shoot. Thus each stolon has capacity to branch—a double chance from each node—and these branches, each of them, has, like the mother stolon, the power to root at the nodes and to end in one flower. The vegetative and reproductive capabilities of the plant are therefore great. *G. Farreri*, *G. Lawrencei*, and *G. sino-ornata* exhibit this stolon-branching to the greatest extent —*G. Veitchiorum* in my experience the least. And this seems to be constitutional. For the former are the most satisfactory of plants, and the flexibility of their parts lends them to the most ordinary of handling. On the other hand, *G. Veitchiorum* seems to be, at Edinburgh, a less adaptable plant—stiffer, less ready to respond.

In the solitary terminal flowers the calyx has an entire tube with long distinct lobes. By entire I should perhaps explain that the tube of the calyx is not split down one side as it is, for instance, in *G. decumbens*—to name a well-known garden plant. The distinction is an important one for differentiation of species of Gentian. The corolla, large and showy, some 5–6 cm. long, obconoid and funnel-shaped, sometimes slightly bulged above the calyx, is of various shades of blue, and has broad paler striped or suffused petaline bands on the outside. The folds, though toothed, are never fringed. The ovary has a long stalk, and the style is also long, with the branches recircinate at the tip.

These Gentians grow at Edinburgh in any good moist garden soil, either in shade or in full sun exposure—flower-

ing perhaps better under exposure. Every shoot will strike —those of the narrow-leaved species most freely.

Gentiana Farreri, Balf. f.[1]

Perennial herb with thick roots and very many branching stolons freely rooting and spreading from a primary central rosette, the stolons forming many new rosettes from the leaf-axils at the rooting nodes. Stolons as much as 18 cm. long prostrate at the base, then ascending, having terete internodes about 1 cm. long and 2 mm. in diameter, generally green and without surface papillae, sometimes reddening. Leaves epetiolate thick opposite, each pair connate and forming a vaginal somewhat loose sheath as much as 5 mm. long; lamina of upper region of stolon over 2 cm. long 2 mm. broad, in the primary rosette as much as 6 cm. long 5 mm. broad (on rosettes of the stolons somewhat smaller), linear not contracted at the base, towards top narrowed into an acute or acuminate apex, margin obscurely scaberulous, on both sides whitely-papillose, concave above dark-green glossy, paler beneath, midrib slightly raised in the sinus of the longitudinal groove. Flower solitary terminal; pedicel stout as much as 1 cm. long 3 mm. in diameter often reddened. Calyx as much as 5 cm. long, slightly shorter than corolla 5-lobed; tube somewhat funnel-shaped not split, as much as 2 cm. long 5 mm. in diameter, somewhat membranous green outside sometimes reddish at the base, intracalycine membrane green truncate transversely rugose; lobes somewhat thick

[1] *Gentiana Farreri*, Balf. f.—Herba perennis stolonifera. Stolones radicantes ramosi ad 18 cm. longi a rosula centrali patentes. Folia stolonum epetiolata opposita vaginato-connata linearia acuta vel acuminata recurva 2 cm. longa vel ultra, 2 mm. lata, vel majora. Flos solitarius terminalis; pedicellus circ. 1 cm. longus. Calycis tubus infundibularis haud dimidiatus circ. 2 cm. longus; lobi duplo longiores lineares recurvi basi haud angustati. Corolla obconoideo-tubulosa ad 6 cm. longa extus vittata vittis flavido-albidis lineato-tinctis intus citrino-maculata, fauce alba; lobis ovatis circ. 8 mm. longis sub-apiculatis methylo-coeruleis nitentibus, plicis 3 mm. longis 7 mm. latis erosis. Filamenta staminum in parte libera circ. 9 mm. longa anguste alata; antherae sagittatae. Ovarium 1·5 cm. longum; stipes circ. 2·2 cm. longus; stylus ad 7 mm. longus ramis stigmatiferis 4 mm. longis recurvis.

Species Sectionis Frigidae *G. Lawrencei*, Burkill affinis sed robustior et calycis lobis tubo triente longioribus, corollae colore facile recognoscenda.

Kansu, in alpibus Jo-Ni.

very long, 3 cm. or more long, barely 1·5 mm. broad, like the uppermost leaves linear acuminate, subequal distant recurved not contracted at the convex base. Corolla obconoid-tubular as much as 6 cm. long spreading to over 3 cm.; tube within the calyx not 5 mm. in diameter, greenish-white, expanding upwards beyond calyx and showing on outside five broad yellowish-white bands on the median of the petals (antipetaline), each band having a central narrow greenish-blue line and a similarly coloured longitudinal ridge on each margin, inside sprinkled with small green and citron-yellow antipetaline spots, the interpetaline areas more or less pale-white and suffused with blue, throat white; lobes 5 broadly ovate or trigonous acute somewhat apiculate, about 8 mm. long and broad, recurving, outside traversed by the antipetaline bands, on the inside shining satiny of a methyl-blue colour; plicae semi-lunate methyl-blue coloured above, underneath paler more opaque, about 3 mm. long 7 mm. broad, erose, the middle tooth longer. Filaments of the stamens free through about 9 mm. and there narrowly winged about 1 mm. broad, intensely purple on the outside, white on the inside; anthers sagittate about 3 mm. long. Ovary 1·5 cm. long; stipe about 2·2 cm. long; style as much as 7 mm. long its stigmatiferous branches about 4 mm. long, recurving.

Kansu. Jo-Ni alps. Farrer and Purdom, 1914.[1]

Specimens of this species were not brought by Farrer, and my description is based upon living plants which flowered in the Royal Botanic Garden in August 1916. They were raised from seeds presented by the late Robert Woodward, Esq., jun., of Arley Castle, Bewdley—a portion of his share in the produce of Mr. Farrer's expedition.

G. Farreri is a superb species, perhaps the finest of the series to which it belongs. The wonderful sheen of the blue of its petals and folds above the white throat is its outstanding flower-feature, and the recurving of the corolla shows off the colour to advantage. It seems to be less affected by weather conditions than is the case with other Gentians. Sunshine is not necessary for the flower-expansion, although in sunshine only is the full glory of its colour displayed. On dull cloudy days as in bright sunshine the plant opens flowers freely. And the flower

[1] See Farrer, On the Eaves of the World, ii (1917), 214, 216.

does not always close on the approach of twilight. There are better and poorer flowered individuals noticeable in the cultivated plants—some opening the trumpet widely, others keeping the corolla-lobes more erect. It begins to flower at Edinburgh in late August, and continues until winter frosts destroy its aerial shoots. Rooting as it does at every node propagation of it is easy.

When in flower there is no other species with which *G. Farreri* can be confused. The Siberian *G. Lawrencei*, Burkill, is its nearest ally, but that wants the fine flower-colour, its flowers do not open in the wide trumpet-form of *G. Farreri*, and its leaves and stem are altogether more delicate. From *G. sino-ornata*, Balf. f., and *G. Veitchiorum*, Hemsl., others of its allies, it is easily diagnosed. They have flowers of a royal blue and purple-blue colour, and the latter has shorter blunt leaves.

Gentiana Lawrencei, Burkill, in Gard. Chron., 3, xxxviii (1905), 307, fig. 119.[1]

G. ornata, Bot. Mag. (1907), t. 8140.

Perennial spreading herb with thick roots and forming a compact rosette from which emerge many long leafy stolons rooting at the nodes. Stolons as much as 15 cm. long thin about 1 mm. in diameter with cylindric usually

[1] Burkill's description runs :—

Gentiana Lawrencei, Burkill.—*G. ornatae*, Wallich, valde affinis foliis autem elongatis distinguitur. Planta perennis diffuse caespitosa. Caules plures, subdecumbentes, nec angulati, ad 10 cm. longi. Folia nitentia, arcuata, per paria vaginato-connata, infima 5 mm. longa, suprema 20 mm. longa, 2 mm. lata, acutissima ; vagina 3 mm. longa. Calycis tubus 12 mm. longus, margine membranaceo integer ; dentes quinque foliis supremis persimiles, parum inaequales, 14–18 mm. longi. Corollae tubus 40 mm. longus, infra albidus et atro-coeruleo-striatus, faucibus coerulescens ; lobi deltoideo-ovati, acuti, laete coerulei, 5 mm. longi, 4 mm. lati ; plicarum lobi late deltoidei, 2 mm. longi, 4 mm. lati, margine subintegri. Filamenta 30–32 mm. longa, ad corollam infra medium annexa, violacea. Ovarium 12 mm. longum ; stipes basi mellifluus fere 20 mm. longus ; stylus 1 mm. longus ; stigmata 8 mm. longa.

A handsome Gentian, brought into cultivation by Herr Max Leichtlin of Baden-Baden. The specimens from which the description is drawn flowered in the garden of Sir Trevor Lawrence at Burford, Dorking, to whom we are indebted for the specimens here illustrated. The original seeds were collected by M. Jules Bocherel on a journey into Mongolia from Lake Baikal. *Gentiana ornata*, its nearest ally, is a native of the Eastern Himalaya and South-West China. *Gentiana ternifolia*, Franchet, is another ally which comes from Yunnan ; *Gentiana tetraphylla*, Kusnezow, and *G. hexaphylla* Maximowicz, are allies growing in

reddening long internodes as much as 2 cm. long in upper part, prostrate at base branching above, each branch ascending and ending in a single flower or some branches arrested and forming nodal rosettes whence new stolons arise. Leaves of the upper region of stolons linear-filiform running out to a long point, as much as 2·5 cm. long hardly 1·5 mm. broad hardly recurving not constricted at base, epetiolate, passing at once into a vagina connate with that of opposite leaf into a sheath about 3 mm. long. Flower solitary terminal; pedicel as much as 1·2 cm. long barely 2 mm. in diameter red. Calyx about 3·5 cm. long; tube funnel-shaped not split, about 1·3 cm. long 3·5 mm. broad angular, shining outside very red at the base, above somewhat blistered, dark-green, inside pale-green slightly rugulose, intracalycine membrane truncate; lobes subequal distant linear-filiform to a long point, over 2 cm. long about 1·5 mm. broad, not contracted at base, somewhat involute dark-green erect spreading not markedly recurved. Corolla obconoid-tubular about 5·5 cm. long spreading to about 2 cm.; tube within the calyx pale-green about 3 mm. in diameter, above that with 5 antipetaline bands greenish-white not spotted but with a central narrow faint purple line and two lateral broader purple boundary ridges, interpetaline areas white tinted pale sky-blue, inside unspotted white rugulose on antipetaline areas, throat striped pale blue and white; lobes 5 broadly ovate or trigonous obtuse and slightly apiculate pale sky-blue about 6 cm. long and broad half patent; folds paler than lobes, about 3 mm. long and 7 mm. wide, broadly triangular erose with a longer often aristate tooth about the middle. Staminal filaments free through 1·2 cm. tinted pale blue, inserted about 2·1 cm. above base of corolla, narrowly winged; anthers sagittate 4 mm. long. Ovary about 1·4 cm. long; stipe 2·5 cm. long; style 6 mm. long its stigmatiferous branches about 1·5 mm.

Siberia. About Lake Baikal. Bocherel.

This species was described and figured by Burkill from Szechuan. The whole group consists of plants with showy flowers, but *G. ornata* is the only one which has been in cultivation prior to the introduction of *G. Lawrencei*.

The flowers of *G. Lawrencei* are $1\frac{3}{4}$ inch long, upright, and blue above, the lower part of the tube being pale, with dark blue lines. They stand solitary on the ends of ascending narrow-leaved branches.

plants which flowered with Sir Trevor Lawrence in 1905. The plant came from Max Leichtlin, who raised it from seed collected by M. Jules Bocherel about Lake Baikal, as Burkill informs us. A plant from the same source was received at the same date at, and its progeny still flourishes in, the Royal Botanic Garden, Edinburgh. The history of the plant figured in the Botanical Magazine (1907),[1] t. 8140, under the name *G. ornata*, Wall., is that of Sir Trevor Lawrence's and of the Edinburgh plant, and the figure is that of *G. Lawrencei*. It is not *G. ornata*, Wall. I do not understand the reference under the figure to Walton's specimens. These were described by Burkill under the name of *G. Waltoni*[2]—a species with a dimidiate-spathaceous calyx altogether different from the type of *G. ornata*.

G. Lawrencei is a pretty species, most like *G. Farreri* of those I speak of here. It is, however, a more slender plant, with thinner stolons and much narrower leaves—they are almost thread-like at times—and they do not recurve in the manner of those of *G. Farreri*. It is very sensitive to atmospheric states, and is therefore at a disadvantage with *G. Farreri*. The flowers are only open in brightest sunshine and in a warm dry atmosphere. The flower has always a purple-red thin stalk, about a centimeter or more in length and little over a millimeter in diameter, and it gives the impression of being scarcely strong enough to support erect the large flower. The calyx-tube is shorter than in *G. Farreri*, as are also the thin almost filiform lobes which remain erect and do not recurve. The expanded mouth of the corolla-tube is only about 2 centimeters across —in *G. Farreri* it is 3 cm.—and the lobes and folds do not reflex to the extent they do in *G. Farreri*, so that the mouth has not the broad trumpet-form of that species. The throat is not pure white as there but lined with blue, and the blunt lobes with the folds, which are somewhat erose, are of a paler sky-blue tint. If it would only open its flowers, which are profusely produced,—as freely as in *G. Farreri* —it would more closely rival that species for favour. *G. Lawrencei* is like *G. Farreri* a long flowerer—opening

[1] See also Gard. Chron., **3**, xl (1906), 182.
[2] Burkill in Journ. Proc. Asiat. Soc. Beng., n.s. ii (1906), 310.

at Edinburgh in late July and continuing during the autumn—and it is as easily propagated.

Gentiana sino-ornata, Balf. f.[1]

G. ornata, Forrest (not of Wallich), in Notes Roy. Bot. Gard. Edin., iv (1907), 71.

G. ornata, Hort. (not of Wallich).

Perennial herb with thick roots producing many spreading rooting stolons from a primary central rosette, and forming new axillary rosettes at the rooting nodes. Stolons 18 cm. or more long, prostrate at the base ascending towards the apex composed of short terete more or less papillate reddish internodes. Leaves epetiolate thick somewhat fleshy opposite connate each pair forming a short vaginal sheath about 2·5 mm. long; lamina in the primary rosette linear-lanceolate from the base as much as 1·5 cm. long 3 mm. or more broad not narrowed at the base, margin in the young leaves whitely cartilaginous subsequently scaberulous and at the base minutely ciliolate, whitely papillate on both surfaces, concave dark-green glossy above, paler beneath, midrib slightly elevated at bottom of longitudinal groove; lamina of lower leaves of stolon small often 5 mm. long 1 mm. broad lanceolate or linear-lanceolate longly acute, of upper leaves as much as 3·5 cm. long 5 mm. broad somewhat cucullate strict not recurving minutely ciliolate at base. Flower solitary terminal; pedicels about 5 mm. long. Calyx about 3·5 cm. long much shorter than corolla, 5-lobed;

[1] *Gentiana sino-ornata*, Balf. f.—Herba perennis diffusa stolonifera. Stolones radicantes ramosi ad 18 cm. longi vel ultra a rosula centrali patentes. Folia stolonum epetiolata opposita vaginato-connata lineari-lanceolata vel a basi lanceolata longe acuta ad 3·5 cm. longa 5 mm. lata sursum concava. Flos solitarius terminalis; pedicellus brevis vix 5 mm. longus. Calycis tubus infundibularis haud dimidiatus circ. 1 cm. longus; lobi circ. 2 cm. longi lineari-acuminati erecti basi haud angustati. Corolla obconoideo-tubulosa ad 6 cm. longa vittata vittis flavido-albidis purpureo-suffusis et lineato-tinctis, intus emaculatis, fauce coerulea; lobis late ovatis acutis circ. 8 mm. longis intense coeruleis nitentibus; plicis circ. 3 mm. longis 8 mm. latis subcrenulatis vel dentatis. Filamenta staminum in parte libera circ. 1 cm. longa anguste alata coerulea; antherae sagittatae. Ovarium circ. 1·4 cm. longum; stipes circ. 2·2 cm. longus; stylus ad 7 mm. longus ramis stigmatiferis circ. 6 mm. longis recurvis.

Species Sectionis Frigidae a *G. Farreri*, Balf. f. et *G. Lawrencei*, Burkill foliis lineari-lanceolatis vel lanceolatis sursum concavis, florum colore intense coeruleo facile recognoscenda; a *G. Veitchiorum*, Hemsl. habitu diffuso foliisque sursum concavis recedens.

N.W. Yunnan.

tube funnel-shaped not split somewhat coriaceous about 1 cm. long or more 4 mm. in diameter reddened at the base outside: intracalycine membrane greenish-white truncate plane glossy: lobes subequal scarcely distant linear-acuminate hardly 2 cm. long 2 mm. broad flat not recurved not contracted at base green sometimes purpling at the tip. Corolla obconoid-tubular as much as 6 cm. long, spreading to about 3 cm.; tube within the calyx narrow yellowish-white, expanding upwards beyond calyx and showing on outside 5 broad bands (yellowish-white and suffused irregularly with purple) on the median of the petals (antipetaline), each band traversed by a central purple-blue line and having on each margin a dark-purple longitudinal ridge, inside transversely rugose without citron-yellow antipetaline spots, the interpetaline areas of a deep blue colour, glossy, throat blue; lobes broadly ovate acute apiculate about 8 mm. long and broad, half-spreading, outside traversed by the antipetaline bands, inside royal-blue-coloured glossy: folds slightly paler more or less oblique broadly triangular obtuse entire or somewhat crenulate or toothed about 3 mm. long 8 mm. broad. Free part of filaments of stamens about 1 cm. long tinted blue narrowly winged; stamens inserted about 2·5 cm. above base of corolla; anthers about 2·5 mm. long sagittate. Ovary about 1·4 cm. long; stipe about 2·2 cm. long; style as much as 7 mm. long its stigmatiferous branches about 6 mm. long recurving.

E.N.W. Yunnan:—Summit of Mi Chang pass between River Yangtze and Chungtien plateau. Alt. 14,000–15,000 ft. Flowers deep blue. G. Forrest. No. 408. Sept. 1904.

E.N.W. Yunnan:—Lichiang Range. Eastern flank. Open mountain meadows. Alt. 11,000–12,000 ft. Lat. 27° 30′ N. Plant of 5–8 ins. Flowers bright blue, plicae green. G. Forrest. No. 6728. Sept. 1910.

E.N.W. Yunnan:—Summit of the Sungkwei pass. Stony open pasture. Alt. 12,000 ft. Lat. 26° 12′ N. Plant of 2–4 ins. Flowers deep clear blue, plicae yellowish-blue, striped and spotted. G. Forrest. No. 7374. Nov. 1910.

W.N.W. Yunnan:—Mekong-Salween divide. Alt. 12,000 ft. Lat. 28° 10′ N. Moist pasture. G. Forrest. No. 13,549. Oct. 1914.

The differentiation of closely allied species of Gentian from dried specimens is a task of some difficulty, and following the lead of Franchet,[1] who had described two Gentians collected by Soulié at and about Tungnglo in W. Szechwan as varieties of the Himalayan *G. ornata*, Wall. under the names *obtusifolia* and *acutifolia*, Forrest's dried earlier Yunnan specimens (under No. 408) of this plant were referred to *G. ornata*. Cultivation of plants (raised from seeds of later specimens under No. 6728) which flowered with Mr. Bulley at Ness and also at Edinburgh in 1912 showed that Forrest's plant was not the true *G. ornata*, and we named our plant a Chinese form of *G. ornata*. Under this designation Forrest's plant has passed out of the Royal Botanic Garden, Edinburgh, dropping sometimes in its spread the qualification "Chinese form," and appearing as *G. ornata*. Under the name *G. ornata* it received an Award of Merit at the Royal Horticultural Society when exhibited on October 12, 1915, by Mr. Amos Perry, who had obtained the plant from Edinburgh. It is not the Wallichian species, which is not now in cultivation, and perhaps never has been. I have not the material by which to form an opinion upon whether Forrest's plant is the same as Soulié's Szechwan plants.

[1] Franchet in Bull. Soc. Bot. Fr., xliii (1896), 493, where he says :—

Gentiana ornata, Wall., Cat. 4386 ; C. B. Clarke, in Hook., Fl. of Brit. Ind., iv, 116 ; Bot. Mag., t. 6514 (forma micrantha).

Species in Se tchuen occidentali variabilis.

α *Obtusifolia*.—Folia inferiora et media oblonga, superiora lanceolato-linearia, omnia obtusa ; flores 4–5 cent. longi, caerulei cum vittis fuscis; plicae ovatae, obtusae.

Les prairies humides, les pelouses fraîches à Tongolo, Tizou, etc. (R. P. Soulié). En thibetain : Aou meto (fleur du frère aîné).

β *Acutifolia*.—Folia media et superiora linearia, acuta vel acuminata ; flores 6–8 cent. longi, anguste tubulosi, lobis margine intense violaceo-caeruleis, tubo cum vittis longitudinalibus atro-violaceis. Flores Gentianae striatae Maxim.

Depuis Tongolo jusqu'au village de Té la to, dans les bois et les lieux secs.

Je n'ai pas vu de la Chine la variété *meiantha*, Clarke, à petites fleurs et à feuilles courtes, récurvées.

Le végétation du *G. ornata* est la même que celle du *G. ternifolia*, Franch. ; les stolons épigés ou hypogés s'enracinent à leur sommet d'où procède un bourgeon feuille qui continuera la plante. Autour de ce bourgeon se développent deux ou plusieurs rameaux ascendants portant chacun une fleur. Dans toutes les formes de la plante la capsule est toujours très longuement stipitée, lancéolée, brièvement attenuée en style court.

The latter are certainly not *G. ornata*, Wall. I shall at the end of this communication deal with the question of the identity of *G. ornata*, Wall., and will add therefore nothing more here on the subject.

Until *G. Farreri* came, I gave the palm to *G. sino-ornata* amongst late-flowering Gentians. Nor do I admit that *G. Farreri* surpasses it at all points. The one is a pale the other a dark flowered species, and both should have a place in every garden.

G. sino-ornata is a late flowerer. The first flowers open usually at Edinburgh in the last days of September, and flowering continues until winter rigours send the plant to rest. It appears to be the most free in growth of the four species referred to here. A small plant from a cutting will increase to a patch a foot or more in diameter within a year. There is no mistaking it for any other species. Its half lanceolate pointed leaves, not narrowed at the base, which may be 5 millimeters broad, are stiff and spreading on the stolons and do not recurve as in *G. Farreri* and *G. Lawrencei*, and though they may approach the length of the leaves in those species, they look much shorter owing to their greater breadth. The pedicel above the uppermost leaves hardly exists, so that the flower looks as if it were sessile on the end of the stolon and not stalked as in *G. Farreri* and *G. Lawrencei*. Then the calyx is much shorter than the corolla, its inner lining has a whitish vesicular appearance, and the calyx-lobes are erect—each of them is flat, tapering from a non-contracted base about 3 millimeters broad to a sharp point. The corolla has a limb about 3 centimeters across when expanded, the throat is blotched inside and not bright white. The apiculate lobes do not reflex to the extent of those of *G. Farreri*, and the folds remain somewhat erect—the whole effect is that of a narrower and more funnel-like not trumpet-shaped mouth. The general colour of the corolla-limb is a rich royal-blue, in marked contrast to the satiny methyl-blue in *G. Farreri* and *G. Lawrencei*. The flowers show all the sensitiveness to light and moisture of most Gentians, only expanding fully under bright sunshine and in a dry atmosphere.

G. Veitchiorum is an altogether different plant in its

compact habit with blunter leaves. Its flowers are of a dark blue as in *G. sino-ornata*, but of a deeper blacker tint.

Gentiana Veitchiorum, Hemsl.[1] in Gard. Chron., 3, xlvi (1909), 178, fig. 74.

G. ornata, Hort. (not of Wallich).

G. ornata, var. *obtusifolia*, Franch. in Bull. Soc. Bot. France, xliii (1896), 493 (acc. to Hemsley).

G. ornata, var. *Veitchii*, W. Irving in Gard. Chron., 3, lviii (1915), 288, fig. 100.

Perennial herb with thick roots and forming a central rosette from which spread many leafy stolons. Stolons

[1] Hemsley's description runs :—

Gentiana Veitchiorum, Hemsl.—Nova species ex affinitate *G. ornatae*, Wall. a qua differt foliis latioribus obtusis, calycis lobis subfoliaceis vix acutis, corollae amplioris lobis latis obtusiusculis et plicis inter lobos latis denticulatis. *G. ornata*, var. *obtusa*, Franch. :—Sinae occidentalis incola, legit. E. H. Wilson.

At least three different species of Gentiana have been, and perhaps are still, in cultivation under the name *ornata*, originally given by Wallich to a Himalayan species, which reaches almost to the upper limits of phanerogamic vegetation in that region. About the year 1880 a Gentian was cultivated in the Edinburgh Botanic Garden bearing this name, and was figured in the Botanical Magazine, pl. 6514, as such; but, as was pointed out by W. I. (Walter Irving) in the Gardeners' Chronicle, 1906, xl, p. 182, the plant represented is not the true *G. ornata* of Wallich. What it really is, is uncertain, and the history of its introduction into cultivation is apparently not on record. In 1883, the Gardeners' Chronicle published (ii, p. 396, fig. 60) an excellent illustration, reproduced in fig. 75, of the genuine *G. ornata* of Wallich, from specimens grown in the Wisley garden of the late Mr. Wilson. Turning to that, I find that it is a slender trailing plant with narrow, very acute leaves and very acute corolla-lobes, with narrow folds between. A coloured figure of the same species was given in the Botanical Magazine for 1907, pl. 8140. Comparing the flowers actually figured in the Magazine with the type of Wallich's species in the Kew Herbarium, I think there is no doubt that it was correctly identified. Mr. J. Hutchinson, who contributed the description of that figure, suggests that the plant figured in the Botanical Magazine, pl. 6514, is *G. nipponica*, but I have not time to follow up this suggestion.

Now comes a third Gentian, to which the name *ornata* has been attached. The species in question was exhibited by Messrs. James Veitch & Sons at the meeting of the Royal Horticultural Society on August 31, and received an Award of Merit. The history of it is as follows :—In August 1906 Messrs. Veitch sent a plant of it to Kew for name, with the information that it was raised from seed collected by Mr. E. H. Wilson near Tatienlu, West China, at an elevation of 12,000 feet. It was identified with dried specimens collected by Père Soulié in the same region and described by Franchet (Bull. Soc. Bot. France, vol. xliii, p. 493), and named *Gentiana ornata*, var. *obtusifolia*. With all the material before me, I have no hesitation in accepting the identification; but I cannot agree in leaving it as a variety of *G. ornata*.

as much as 10 cm. long 2 mm. in diameter with cylindric internodes reddened more or less as much as 1·5 cm. long sometimes puberulous, prostrate at base ascending towards summit and ending in one flower or becoming arrested and forming a rooting rosette from which new stolons emerge. Leaves of upper part of stolon very shortly petiolate, opposite, thick somewhat fleshy, recurving about 2 cm. long 6 mm. broad above the connate vaginae of the nodal pairs, vaginal sheath about 4 mm. long or less adpressed to stem at mouth; lamina linear-oblong narrowed to the apex obtuse or acutish shortly mucronulate, margin finely scaberulous, contracted at the base into a very short petiole with somewhat membranous margins which are somewhat ciliate, upper surface dark-green somewhat glossy, on both surfaces minutely whitely papillate, lower surface paler with a slightly raised midrib; leaves of lower part of stolon ovate or elliptic or oblong always obtuse. Solitary terminal flower with a pedicel at most about 2 mm. long, reddened. Calyx about 3·3 cm. long much shorter than corolla, 5-lobed; tube funnel-shaped not split about 1·5 cm. long 4·5 mm. in diameter reddish at base outside, thin, intracalycine membrane yellow-green truncate somewhat vesicular white and membranous at the sinuses; lobes nearly equal about 1 cm. long 2 mm. broad linear-lanceolate acute and apiculate or mucronulate, in colour like the foliage-leaves, not recurved, at base contracted and there vesicular on upper surface. Corolla obconoid-tubular 5–6 cm. long; tube within the calyx greenish-white not tinted, expanded upwards showing outside 5 broad greenish-yellow bands (suffused faintly with purple) on median of petals (antipetaline), each band with a central keeled purple line and on each margin a broader similar ridge, the interpetaline areas deep purple, inside smooth with some purple antipetaline spots, throat black purple; lobes 5 broadly triangular or rather

Considering the large number of described Chinese species of which I have seen no authenticated specimens, there is some risk of duplication in proposing another, but that is the only course open under the circumstances.

G. Veitchiorum is a larger, more robust plant than *G. ornata*, with relatively broad, obtuse leaves, larger flowers, with broader corolla-lobes, and very broad toothed folds between them. The flowers are of an intense blue with light longitudinal bands on the outside.

trigonous apiculate about 7 mm. long and broad patent and recurving, traversed by the antipetaline bands outside, deep royal-blue inside; folds about 2 mm. long 4·5 mm. broad slightly paler blue with a triangular central obtuse tooth and slight erosion at the sides. Staminal filaments free from about 2·8 cm. above base of corolla, free portion about 1·2 cm. long pale violet and spotted, narrowly fringed; anthers sagittate about 2·8 mm. long. Ovary about 1·4 cm. long; stipe about 2·7 cm. long; style as much as 6 mm. long its stigmatiferous branches recurved 2 mm. long.

W. Szechwan. Wilson.

G. Veitchiorum is a fine garden plant, although not, I think, of the merit of *G. Farreri* and *G. sino-ornata*. It was introduced to cultivation, as Hemsley informs us, by Messrs. Veitch, who raised it from seed collected by E. H. Wilson in W. Szechwan. When describing it as a species distinct from *G. ornata*, Wall., Hemsley identified it as the plant which Franchet described under the name *G. ornata*, var. *obtusifolia*. Subsequently W. Irving gave it the name *G. ornata* var. *Veitchii*.

Without doubt Hemsley was right in giving the plant specific rank and separating it from *G. ornata*, Wall., which is a different plant. But the name *G. ornata* somehow got attached to it, and it received an Award of Merit at the Royal Horticultural Society on August 31, 1909, when shown by Messrs. Veitch under the name *G. ornata*. I may state here definitely that this plant so laureated was not the same as that which under the same name received an Award of Merit in 1915. Two species have been exhibited under the name *G. ornata* and each has received an Award of Merit. Neither of them is *G. ornata*, Wall. The plant shown in 1909 is *G. Veitchiorum*, that in 1915 is *G. sino-ornata*.

G. Veitchiorum may be distinguished at a glance from the three late-flowering species which I have already mentioned—*G. Farreri*, *G. Lawrencei*, and *G. sino-ornata* —by its habit and foliage. It is a stiffer more compact grower, and the stolon early leaves are ovate or elliptic or oblong, contracted at base of lamina and blunt at the apex. The stolons themselves are thick with short internodes. The plant is, to our experience at Edinburgh, by no means

so free a grower as the others. Its flower is dark blue, likest that of *G. sino-ornata* but darker in colour.

The following key may aid growers in distinguishing these Gentians in the garden :—

A. Diffuse plant. Stolons slender loosely and widely spreading up to 18 cm. long. Stolon-leaves epetiolate narrow linear or linear-lanceolate tapered to a long acute point, not contracted at base.

a. Flowers distinctly stalked, light blue with satiny sheen, throat white or pale blue and white.

1. Stolon upper leaves dark green strongly recurved over 2 cm. long about 2 mm. wide at base. Pedicel above last leaf-pair about 1 cm. long dark red. Calyx-tube about 2 cm. long, lobes twice as long linear recurved not contracted at base. Corolla throat white, lobes somewhat apiculate bright satiny methyl-blue strongly recurving. Spread of corolla over 3 cm. . *Farreri*

2. Stolon upper leaves pale green erect hardly recurved over 2 cm. long about 1 mm. wide at base. Pedicel above last leaf-pair over 1 cm. long red. Calyx-tube about 1 cm. long or a little more, lobes twice as long filiform erect not recurved not contracted at base. Corolla throat lined pale blue and white, lobes obtuse pale blue hardly recurving. Spread of corolla about 2 cm. . . . . *Lawrencei*

b. Flowers sessile or nearly so, throat dark pure blue.

3. Stolon upper leaves pale green strict spreading not recurved over 2 cm. long and 5 mm. wide at base. Pedicel above last leaf-pair nearly absent at most 5 mm. long. Calyx-tube about 1 cm. long, or a little more, lobes not twice as long linear flat somewhat spreading not recurved not contracted at base. Corolla-lobes apiculate royal-blue recurving. Spread of corolla about 3 cm. . . . . *sino-ornata*

B. Compact plant. Stolons stout short close. Stolon-leaves shortly petiolate linear-oblong or oblong obtuse or somewhat acute, contracted at base.

c. Flowers sessile or nearly so, throat dark purple-blue.

4. Stolon upper leaves dark green horizontal about 2 cm. long and 6 mm. wide. Pedicel hardly visible above last leaf-pair. Calyx-tube about 1·5 cm. long more or less, lobes shorter than or at most equal to tube erect not recurved contracted at base. Corolla-lobes apiculate deep purple-blue . . *Veitchiorum*

In the preceding pages I have made reference frequently to *G. ornata*, Wall., and have pointed out that three of the late-flowering species of which I furnish descriptions have been confused with it and received its name. It may be well, therefore, if I say something here about what *G. ornata*, Wall., really is and what it is not, and endeavour to clear up the confusion that attaches to the name.

G. ornata, Wall., is a plant obtained by Wallich from Gossain Than in Nepal in the years 1820–21. It appears in his Catalogue under No. 4386. Specimens of the Gossain Than plant are preserved in several public herbaria, of which Edinburgh is one, and the Wallichian specimens which we have are those upon which I rely for my knowledge of what *G. ornata*, Wall., is.

Wallich's plant was first fully described under the genus Gentiana by Grisebach [1] in 1839 and again in 1845.[2]

Previously, in 1838,[3] George Don had given a description of it as *Pneumonanthe ornata*. George Don does not refer to it as a garden plant, and we may assume that it was not in cultivation at the time of his writing.

In 1880 a plant was figured in the Botanical Magazine, t. 6514, under the name *G. ornata*, Wall. This plant came from the Royal Botanic Garden, Edinburgh. I have found no record of whence Edinburgh obtained it, but I am disposed to think that it was raised from seeds distributed from Calcutta. It was soon recognised that this plant was

[1] Grisebach, Gen. et Sp. Gentianearum (1839), 277. The following is Grisebach's description :—

Gentiana ornata, Wall.—Radix dense fasciculata, quasi nidum referens, epidermide versus apicem incrassata patula radicemque sacculi instar cingente. Caules plurimi 3–4-unciales, plerique fertiles, foliosi, declinati 1 adscendentes. Folia 8 longa, 1 lata, suprema longiora, cetera aequalia internodia aequantia, vagina apice ampliata. Calycis tubus patulus lobos aequans ; lobi acuminati membrana intracalycina truncata prominula distantes. Corolla calyce duplo major, coerulea longitudinaliter striata ; lobi acutissimi, mucronati, tubo 4plo breviores, plica obtusa duplo majores. Capsula oblongo-linearis, utrinque attenuata, corollam aequans. Semina oblonga, convexa, processibus scariosis asperrima, utrinque obtusa, nec alata.

Proxima inter nostrates *G. frigida*, Hk., a qua differet caulibus caespitosis, calyce, foliis summis majoribus, omnibus brevioribus, vagina foliari ampliata, flore solitario sessili etc. Cf. ad calcem generis *G. Kurroo*.

Gossain Than, Himalayah.

[2] In DC., Prod. ix (1845), 110.

[3] George Don, Gard. Dict., iv (1838), 194.

not the true *G. ornata*.[1] Hutchinson[2] suggests that it is near *G. nipponica*, Maxim.

C. B. Clarke[3] brought into Wallich's species the "abundant material" of Sikkim specimens collected by Sir Joseph Hooker and others, and cites the erroneous figure of the Botanical Magazine, t. 6514. I have not had opportunity to examine the specimens dealt with by Clarke, but I note an important phrase in his description: "Radical leaves 0 or inconspicuous at flowering time." Now that does not apply to Wallich's Gossain Than plants. Our specimens show a conspicuous leafy rosette with long leaves in the flowering plant. On the other hand, the description does fit Sikkim plants (and I may add Bhutan ones), of which we have specimens. In them a leafy "radical" rosette is apparently not formed. Of this I shall write something later. Here I will only say that I suspect some—shall I say much ?—of the Sikkim material is not *G. ornata*, Wall. Of the var. *meiantha* which Clarke regards as a "very dubious plant," I can say nothing.

In the same year (1883) as the Gentianaceae of Hooker's Fl. of Brit. Ind. appeared, there was published over the name *G. ornata* in the Gardeners' Chronicle[4] a figure of a plant grown by Mr. Wilson at Wisley—probably from Calcutta seed. The plant is not *G. ornata*, Wall. The tuft of short ascending potential stolons in the centre of the far-spreading flowering stolons is not a character of *G. ornata*, but is found in another species of Gentian which extends from Sikkim into Bhutan. I shall describe presently this species under the name *G. prolata*. The construction to which I call attention is of biological import. It means that the stolons are biennial. The dried specimens of Wallich's Nepal *G. ornata* show annual stolons. I am disposed to interpret the figure as a representation of *G. prolata*. It cannot be *G. ornata*, Wall.

In 1896 the first Chinese plants to be identified with *G. ornata*, Wall. were described by Franchet.[5] On p. 255

[1] Later pointed out in Gard. Chron., 3, xl (1906), 182, and again 3, xlvi (1909), 178.
[2] Hutchinson in Bot. Mag. (1907), t. 8140.
[3] Clarke in Hook., Fl. Brit. Ind., iv (1883), 116.
[4] Gard. Chron., 3, ii (1883), 396, fig. 60.
[5] Franchet in Bull. Soc. Bot. France, xliii (1896), 493.

is quoted what Franchet says. Some specimens collected by Soulié at and near Tungnglo, Franchet referred to *G. ornata*, Wall. (taking that species in the sense of C. B. Clarke), as varieties—one *G. ornata*, var. *obtusifolia*, the other var. *acutifolia*. I have pointed out elsewhere that Franchet, in his pioneer work on the Western Chinese Flora, was cautious and conservative, preferring to aggregate Chinese forms with Indian types rather than to segregate. This is an example. I have seen specimens of both the varieties, though I have not had opportunity to examine them critically, and in the light of our increased knowledge it is certain that neither is the typical *G. ornata*, Wall. Whether they are to be identified with any of the forms I have already spoken of in this paper I cannot say. Hemsley[1] is perhaps right in identifying the var. *obtusifolia* with his *G. Veitchiorum*.

Kusnezow[2] (1904) follows C. B. Clarke, but concludes that *G. ornata*, Wall. is a variable species. The plant of the Bot. Mag., t. 6514, may be a special variety. He cites the figure in the Gardeners' Chronicle for 1883 as *G. ornata*.

In 1907 there appeared in the Bot. Mag., t. 8140, an illustration with the name *G. ornata*, Wall. The same plant is referred to in the Gard. Chron. for 1906.[3] I have already (p. 252) written of this, but will repeat here in order to complete my notes of *G. ornata*. Hutchinson, who writes the text to the figure, gives the story of the plant. It reached Kew in 1905 from Max Leichtlin. This is the history of the plant which flowered with Sir Trevor Lawrence in 1905, and is described and figured by Burkill[4] as *G. Lawrencei*. A plant came to Edinburgh from Max Leichtlin in the same year, and it is *G. Lawrencei*. The Bot. Mag. figure is certainly not a representation of *G. ornata*, Wall. It represents, I believe, *G. Lawrencei*.

In the same year George Forrest published[5] an account of some Gentians he had collected in Yunnan, and accepting Franchet's recognition of *G. ornata*, Wall., as a West Chinese species, assigned to it the plant which is described

[1] Hemsley in Gard. Chron., 3, xlvi (1909), 178, fig. 74.
[2] Kusnezow in Acta Horti Petrop., xv (1904), 268.
[3] Gard. Chron., 3, xl (1906), 182.
[4] Ibid., 3, xxxviii (1905), 307, fig. 119.
[5] G. Forrest in Notes Roy. Bot. Gard. Edin., iv (1907), 71.

on a preceding page as *G. sino-ornata*, and this plant, as I have explained, is one of those which in cultivation often bear the name *G. ornata*.

Hemsley[1] in 1909, when describing Wilson's Szechwan plant, raised by Veitch, as *G. Veitchiorum*, concludes that his plant is *G. ornata*, var. *obtusifolia*, Franch. As I have previously said (p. 259), Hemsley was right in giving this plant specific rank.

Then in 1915 Irving,[2] in the text attaching to a figure of *G. Veitchiorum*, Hemsl., whilst agreeing with Hemsley that this *G. Veitchiorum* is *G. ornata*, Wall., var. *obtusifolia*, Franch., maintains that *G. ornata*, Wall. does extend into China, that *G. Veitchiorum* is only a variety of Wallich's type, and that the same plant was laureated by the Royal Horticultural Society in 1909 and in 1915. As the Franchetian varietal name *obtusifolia* is already attached to another species, Irving renames *G. Veitchiorum*, calling it *G. ornata*, var. *Veitchii*. But *G. ornata*, Wall. does not extend into China. *G. Veitchiorum* is a distinct species. The plants which received Awards of Merit in 1909 and in 1915 under the name *G. ornata* were not the same. The 1909 plant was *G. Veitchiorum*. The 1915 plant was *G. sino-ornata*.

From this history it will be learned that the name *G. ornata*, Wall. has been attached at different times to plants coming from Nepal and Sikkim on the West, Yunnan and Szechwan on the East, and Baikal and N. Mongolia on the North. I know it for certain only in Wallich's Nepal specimens, but it possibly occurs also in Western Sikkim. From amongst the forms that have been included in it we can segregate these species:—*G. Lawrencei*, *G. prolata*, *G. sino-ornata*, *G. Veitchiorum*, and the unidentified plant of the Bot. Mag., t. 6514.

The following is a description of *G. ornata*, Wall., based upon the plants from Gossain Than:—

Gentiana ornata, Wall. Cat., 4386; Griseb. Gen. et Sp. Gentianearum (1839); id. in DC., Prod., ix (1845), 110. *G. ornata*, Clarke in Hook., Fl. Brit. Ind., iv (1883), 116. Nepal plant only.

[1] Gard. Chron., 3, xlvi (1909), 178, fig. 74. See p. 257 of this paper. Ibid., 3, lviii (1915), 288, fig. 100.

G. ornata, Kusnezow in Acta Horti Petrop., xv (1904), 268. Nepal plant only.

Pneumonanthe ornata, George Don, Gard. Dict., iv (1838), 194.

Excluded are:—

G. ornata of Bot. Mag. (1880), t. 6154.

G. ornata of Gard. Chron., 3, ii (1883), 396, fig. 60.

G. ornata, var. *acutifolia*, Franch. in Bull. Soc. Bot. France, xliii (1896), 494.

G. ornata, var. *obtusifolia*, Franch. in Bull. Soc. Bot. France, xliii (1896), 493.

G. ornata of Gard. Chron., 3, xl (1906), 182, and of Bot. Mag. (1907), t. 8140.

G. ornata, G. Forrest in Notes Roy. Bot. Gard. Edin., iv (1907), 71.

G. ornata, var. *Veitchii*, W. Irving in Gard. Chron., 3, lviii (1915), 288, fig. 100.

A perennial herb with a very short rhizome crowning the long fleshy roots and producing a close rosette, conspicuous at the flower-period, of linear somewhat fleshy leaves as much as 2·5 cm. long and 2 mm. broad, acute at the apex and expanding at base into a wide vagina connate with that of the opposite leaf to form a sheath. From the rosette radiate many prostrate short branches (at most about 5 cm. long) which ascend at the point and end in a solitary sessile flower. Stem of the shoots thin about 1 mm. in diameter, longest internodes about the middle and there about 0·5 cm. long, slightly tinted red. Leaves at base of shoots with an oval lamina about 4 mm. long and 2 mm. broad somewhat fleshy, obtuse or acute, slightly cartilaginous and obscurely scaberulous at the margin, at the base contracted into a short parallel-sided petiolar portion about 1 mm. long, which expands into a vagina connate with that of the opposite leaf to form a membranous (when dry) sheath about 2 mm. long open at the mouth; leaves at the top of the shoot with a linear-lanceolate lamina about 1·2 cm. long and 3 mm. broad shortly mucronulate, margin thinly cartilaginous and obscurely scaberulous, contracted at base into a petiolar portion about 1·5 mm. long, vaginal sheath of the leaf-pair about 3 mm. long membranous and open at top. Flower sessile

varying in size. Calyx (in larger flower) about 2·4 cm. long; tube funnel-shaped not cleft reddish outside about 1·4 cm. long somewhat thin not rugose inside, intracalycine membrane truncate, 5-lobed; lobes about 1 cm. long and 1 mm. broad subequal narrow linear acute, margin slightly cartilaginous and obscurely scaberulous, not contracted at base, intersepaline sinus about 1·75 mm. broad. Corolla clavate (in larger flower) 4·3 cm. long (but sometimes only 3 cm.) striate outside with broad bands along middle of petals, each band with three equidistant coloured lines (no trace of spots in dried specimen); tube within the calyx about 2 mm. in diameter, ampliate above and 5-lobed; lobes about 6 mm. long and 5 mm. wide at base broadly triangular acute and mucronulate erect or only slightly spreading in flower; folds broad about 7 mm. across, one-fifth or one-quarter the length of the lobe with a central more or less triangular tooth and elsewhere more or less erose or slightly toothed. Stamens (in larger flower) free from about 1 cm. above base of corolla, free portion about 1·2 cm. long narrowly winged; anther about 3 mm. long. Gynaeceum shorter than stamens; stipe longer than ovary; ovary linear fusiform.

Nepal. Gossain Than.

On a previous page (p. 262) I have stated that some of the Sikkim material (more or less) placed in *G. ornata*, Wall., belongs to a distinct species which I name *G. prolata*, of which the fig. 60 in the Gard. Chron. (3, ii (1883), 396) is a representation. This will be found to be, I believe, a type not uncommon in Sikkim, and it certainly extends into Bhutan. I have been able to study this plant in living flowering specimens raised from seed obtained in Sikkim by Cave and in Bhutan by Cooper. Cave's seeds came under the name *G. ornata*. The following is a description of this species:—

Gentiana prolata, Balf. f.[1]

G. ornata, Hort. in Gard. Chron., 3, ii (1883), 396, fig. 60.

[1] *Gentiana prolata*, Balf. f.—Herba perennis stolonifera. Stolones eradicantes ramosi biennes a rhizomate multicipite centrali erosulato ad 18 cm. patentes. Folia breviter petiolata opposita vaginato-connata,

G. ornata, Clarke in Hook., Fl. Brit. Ind., iv (1883), 116, in part.

G. ornata, Kusnezow in Acta Horti Petrop., xv (1904), 268, in part.

A perennial herb with a copiously branched root-system, the main branches somewhat thick and fleshy, crowned by a multicipital rhizome which does not form a leaf-rosette but emits many erect stout leafy shoots in a central cluster which become prostrate towards the end of first year's growth but do not root, and after elongation in their second year to as much as 18 cm. turn upwards and end each in a single sessile flower. Each branch may be simple or towards the end bear some (4–5) short lateral upturned branches each of which ends in a solitary sessile flower. At time of flowering of the prostrate shoots the shoots to flower in following year are conspicuous. Shoots bear decussate leaves from base upwards; the internodes at base of whole shoot and of beginning of second year's growth shorter, the longest internodes about 1 cm. long. Leaves more or less thick succulent connate in pairs by the vaginae to form a closely adpressed scaberulous sheath round the stem; lower leaves of the shoot smaller, lamina in the smaller lower leaves elliptic about 4 mm. long by 2 mm. broad or larger, in the larger upper ones lanceolate or oblong about 1·4 cm. long and 5 mm. broad, apex obtuse with very short mucro, margin slightly cartilaginous and scaberulous, base slightly contracted to a broad membranous parallel-sided petiole about 1 mm. long in the smaller leaves, 2 mm. in the larger, passing into the leaf-sheath, surfaces with stomatic punctulations. Calyx about 1·5 cm. long (after flowering larger) entire, tube obconoid-tubular often reddened outside about 1 cm. long or less somewhat thin

infera elliptica, supera lanceolata vel oblonga obtusa ad 1·4 cm. longa 5 mm. lata basi contracta. Flos solitarius terminalis sessilis. Calycis tubus infundibuliformis haud dimidiatus circ. 1 cm. longus; lobi dimidio breviores oblongi acuti basi haud contracti. Corolla clavata 3·5–4 cm. longa extus vittata vittis 3-lineatis pauci-maculatis, fauce purpureo-suffusa; lobis late triangularibus vel ovatis circ. 3 mm. longis pallide coeruleis; plicis circ. 2 mm. latis sub-erosis et dentatis. Filamenta staminum in parte libera circ. 8 mm. longa purpurea anguste alata; antherae sagittatae. Ovarium vix 1 cm. longum; stipes circ. 2 cm. longus; stylus circ. 2 mm. longus ramis stigmatiferis circ. 1 mm. longis recurvis.

Sikkim; Bhutan.

not rugose inside, intracalycine membrane truncate; lobes 5 subequal about 5 mm. long or a little longer by about 1·5 mm. broad oblong acute, shortly apiculate not contracted at base, intersepaline sinus under 0·5 mm. broad seldom more, margin scaberulous. Corolla 3·5–4 cm. long clavate; tube within calyx very narrow about 1·5 mm. in diameter ampliate upwards and 5-lobed, purple striate outside on a yellowish ground having 5 bands one along middle of each petal, bands marked by 3 purple equidistant lines and a few spots; lobes and folds blue erect hardly spreading; lobes broadly triangular or ovate about 3 mm. long and 3 mm. broad at base slightly apiculate, folds about 2 mm. broad showing a central tooth about 0·25 mm. high and slight erosion at its sides. Stamens free from about 18 mm. above base of corolla, free filament purple narrowly winged about 8 mm. long; anther 1·5 mm. long sagittate. Gynaeceum about 3 cm. long; ovary fusiform not 1 cm. long stipitate; stipe about 2 cm. long; style about 2 mm. long stigmatiferous through about half its length and there recurved. Capsule about 1·5 cm. long oblong, but slightly tapered to the ends, far exserted from corolla on a stipe as much as 5 cm. long. Seeds ovoid about 1 mm. long by 0·5 mm. broad with straw-coloured alveolar testa.

Bhutan. Parsheng, Timpu. Alt. 14,000 ft. Cooper. No. 3499. 27th October 1914.

Sikkim. Kapup. Cave. 31st October 1916.

G. prolata flowered at Edinburgh in 1917. The plants were raised from seeds taken from Cooper's Bhutan specimens. This was not the first flowering at Edinburgh. In the nineties of last century plants were raised and flowered from Calcutta seed which came with the name *G. ornata*.

The habit of the plant is very different from that of *G. ornata*, Wall., as that appears in the type-specimens. A plant of *G. prolata* in flower shows a central tuft of several erect branches 5 or 6 cm. long, with short more or less elliptic bright green leaves springing from a common many-headed rhizomatous axis from which descend the much-branched roots which are somewhat thick at their point of origin. The base of each of these shoots begins with some scale-leaves. Spreading out from these and arising

from the same rhizomatous axis are several decumbent non-rooting stolons some 18 cm. or so long which are unbranched through about two-thirds of their length and bear a few branches in about the upper third. Upon the unbranched portion two regions are to be recognised—a lower, which may be half the length of the whole, less or more, is clad with small more or less elliptic straw-coloured or brown withered leaves, the upper bears larger green fresh leaves increasing in size upwards and without interruption into the branched region where they are larger than elsewhere. The limit between the lower and upper regions of this unbranched portion is clearly marked by the leafage, for at the point of junction the leaves are particularly small often appearing almost as scale-leaves; and then there is the contrast between the withered and fresh leaves. The junction marks the limit between the growth of two successive years. Each of these stolons shows two years' growth. The leaves of the first year's growth are withered, those of the second are green and active and the portion of stolon bearing them ends itself in a solitary flower and gives origin from the leaves immediately beneath this terminal flower to some 4 or 5 or more lateral short leafy curvingly ascending shoots each in the axil of a leaf and ending in a solitary flower. The flower terminating the stolon expands first, the lateral ones expand in succession from below upwards and we have a typical definite racemose branching. Normally only one leaf of each pair in dextrorse sequence gives origin to an axillary flower-branch. Sometimes in vigorous stolons some of the leaves lower down upon this green leafy part of the stolon may form axillary buds. These are weak vegetative shoots which do not reach an advanced stage of development.

After flowering and at the end of the vegetative season the whole of these branched stolons die back to the base —crisply desiccating not soddenly rotting—and remain attached to the rhizomatous axis around the group of green shoots in the middle. These green shoots have by this time altered their direction. They are now nearly in or are approaching the prostrate lie, their growth in length is arrested, the ultimate leaves being very small, but I do not

find anything of the nature of a scale-leaf bud. It is a green-leaf bud. In this condition they remain during the winter period of rest as incipient stolons. Some of the basal leaves wither, but there is always a group of green leaves at their top. These are perennating stolons.

The recurrence of the active vegetative period sees two developments in these stolons—one at their base, one at their apex. At their base buds in the axils of the lowermost scale-leaves grow out as erect green shoots and eventually form the central tuft which is so conspicuous at the flowering period of the plant. At their apex growth in length is resumed and a longer portion is added which forms the green leafy flowering termination to the stolon.

Thus the features of the plant in flower are explained. The long flowering stolons are biennial. The demarcation of the lower and upper regions in the unbranched area of the stolon indicates, as I have said, the limit between a first year's growth and a second year's growth. The green erect shoots of the tuft in the middle of the spreading stolons are the stolons in their first year of growth. Branching of the one-year-old stolons is limited to the base—to the formation of new stolons. Branching of the two-year-old stolons is limited to the apex—to the formation of flower-shoots. The long intermediate region is unbranched. The bases of all the stolons go naturally to the formation of the short rhizomatous axis of the plant, and possibly latent buds may exist or new buds may form at the base of flowered stolons, but I do not know if this is the case. But there is not found on the central rhizomatous axis a rosette of conspicuous green linear and pointed leaves standing up above the bases of the flowering stolons.

In contrast with this construction in *G. prolata*, I find in *G. ornata*, Wall., at flowering time a central rosette of many linear pointed leaves—radical leaves of many systematic descriptions—crowning the roots which are thick at their origin, branching freely as they pass into the soil. Spreading out from this rosette are short, non-rooting stolons, each ending in a solitary flower. I see no trace of biennial growth upon them. They suggest annual growths.

Not having living specimens of *G. ornata*, Wall., I cannot write with the same certainty of its life-history as I can of

G. prolata, of which living plants are before me. But one has only to put side by side Wallich's Gossain Than dried specimen of *G. ornata* and specimens of the Sikkim plant which I am calling *G. prolata* to recognise that the whole habit and growth in the two plants is quite different and that they are different species.

I cannot say whether *G. prolata* is to prove a free-growing hardy garden plant or not. It will certainly never rival those great acquisitions to our gardens—*G. Farreri* and *G. sino-ornata*. Were I limited to two blue-flowering autumn species these are the two I would select.

The following is a summary of the results of my analysis of the nomenclature and figures of these Gentians that are under review :—

G. Farreri, Balf. f. Kansu species.
In cultivation.
G. Lawrencei, Burkill. Siberian species.
In cultivation.
Is the *G. Lawrencei* of Gard. Chron., 3, xxxviii (1905), 307, fig. 119.
Is the *G. ornata* of Gard. Chron., 3, xl (1906), 182.
Is the *G. ornata* of Bot. Mag. (1907), t. 8140.
G. ornata, Wall. Nepal species.
Not in cultivation. Probably never has been.
Is the *G. ornata* of Hook., Fl. Brit. Ind., iv (1883), 116. Nepal plant.
Is the *G. ornata* of Acta Horti Petrop., xv (1904), 268. Nepal plant.
G. ornata, var. *acutifolia*, Franch. Szechwan form.
Is not *G. ornata*, Wall.
G. ornata, var. *obtusifolia*, Franch. Szechwan form.
Is not *G. ornata*, Wall.
May be *G. Veitchiorum*, Hemsl.
G. prolata, Balf. f. Sikkim and Bhutan species.
Is in cultivation and has been more than once previously in cultivation.
Is the *G. ornata* of Gard. Chron., 3, ii (1883), 396, fig. 60.
Is the *G. ornata* of Hook., Fl. Brit. Ind., iv (1883), 116. Sikkim plant (? all).
Is the *G. ornata* of Acta Horti Petrop., xv (1904), 268. (Except Nepal plant.)
G. sino-ornata, Balf. Yunnan species.
In cultivation.
Is the *G. ornata* of Notes R.B.G. Edin., iv (1907), 71.
Is the *G. ornata* which received Award of Merit, Royal Horticultural Society, Oct. 12, 1915.
G. Veitchiorum, Hemsley. Szechwan species.
In cultivation.
Is the *G. Veitchiorum* of Gard. Chron., 3, xlvi (1909), 178, fig. 74.
Is the *G. ornata* var. *Veitchii* of Gard. Chron., 3, lviii (1915), 288, fig. 100.
Is the *G. ornata* which received Award of Merit, Royal Horticultural Society, Aug. 31, 1909.

FIGURES.

G. Lawrencei of Gard. Chron., 3, xxxviii (1905), 307, fig. 119 . . . = *G. Lawrencei*, Burkill.
G. ornata of Bot. Mag. (1880), t. 6514 . = Uncertain what the figure represents.
G. ornata of Gard. Chron., 3, ii (1883), 396, fig. 60 . . . . . = *G. prolata*, Balf. f.
G. ornata of Bot. Mag. (1907), t. 8140 . = *G. Lawrencei*, Burkill.
G. ornata, var. *Veitchii* of Gard. Chron., 3, lviii (1915), 288, fig. 100 . . = *G. Veitchiorum*, Hemsl.
G. Veitchiorum of Gard. Chron., 3, xlvi (1909), 178, fig. 74 . . . = *G. Veitchiorum*, Hemsl.

Envoy.

The name *Gentiana ornata* should be dropped out of the literature of gardens. It is not in cultivation. Probably never has been. The place which its attractive name seems to claim for it is now occupied by much finer Chinese species.

The Genus Nomocharis.

By Professor Bayley Balfour, F.R.S.

(Read February 14, 1918.)

Of the many remarkable plants which recent exploration of Western China has brought to our knowledge, none take precedence over those which Franchet included in his new genus Nomocharis. They are liliaceous, and occupy a position in the family between Lilium itself and Fritillaria. In that area are several plants whose relationship with Lilium on the one hand and Fritillaria on the other are subjects of discussion, and if Nomocharis adds another to this group of forms, it also brings information which throws light upon the affinities of debatable species. Franchet named only one species—*N. pardanthina*—when he described the genus Nomocharis, and by way of introduction to what I am to say about the genus, I give hear a translation of Franchet's description of both genus and species:—

Nomocharis, Franch.[1]

"Perianth deciduous, segments spreading dissimilar; calycine segments ovate, shortly acuminate, quite entire,

[1] Franchet in Journ. de Bot. iii (1889), 113. Franchet's words are:—
Nomocharis.—Perianthium deciduum, segmentis patentibus dissimilibus; calycis segmenta ovata, breviter acuminata, integerrima, foveola destituta; petala late ovata, margine dentato-fimbriata, basi foveolata; foveola magna, flabelliformis, e medio a limbo soluta, multifida, lobis oblongis incisis; stamina 6, basi segmentis breviter coalescentibus illisque duplo breviora; filamenta inferne circiter ad medium usque inflato-claviformia, parte inflata cava apice rotundata, exinde subulata; antherae oblongo-ovatae, medio dorsofixae, e latere longitudinaliter dehiscentes; discus tenuis, annularis, integer, parvus; ovarium sessile, ovato-oblongum, triloculare, loculis multiovulatis; stylus capsulae subaequilongus, apice paulo incrassatus, stigmate obscure trilobo; capsula ignota.

Bulbus squamosus, squamis albidis oblongis, carnosis, imbricatis; fibrae radicales crassae, nunc fusiformes, villosae; caulis pedalis vel paulo ultra; folia lanceolata, sparsa vel 3–6 verticillata; flores 1 vel 3–4 axillares, speciosi, virginei subnutantes; sepala pallide rosei, saepius immaculati; petala rubescentia, maculis violaceis conspersa, foveola nigro-purpurea.

Genus inter Lilium et Fritillariam medium; bulbi indole, antheris dorsofixis styloque Liliis vere affinis; petalis foveolatis ad Fritillariam vertitur. Ab utroque genere differt: staminum filamentis parte inferiore inflatis, cavisque; foveola multifida et semilibera, quod in nullo

destitute of foveola; petaline segments broadly ovate, margin dentate-fimbriate, foveolate at base; foveola large, fan-shaped, forming a free limb above the middle, much cleft, lobes oblong, incised; stamens 6, slightly adhering to the base of the perianth-segments and one-third their length; filaments from base to the middle inflated-club-shaped, inflated portion hollow, rounded at summit, beyond the inflated portion subulate; anthers oblong-ovate, dorsi-fixed at the middle, dehiscing longitudinally at the sides; disk thin, annular, entire, small; ovary sessile, ovate-oblong, trilocular, loculi many-ovuled; style about equalling in length the ovary, apex slightly thickened, stigma obscurely trilobed; capsule unknown.

"Bulb squamate, scales whitish oblong, fleshy, imbricate; root-fibres thick, sometimes fusiform, villous; stem a foot high or a little more; leaves lanceolate, sparse or 3–6 in a whorl; flowers 1 or 3–4 axillary, showy, slightly nodding; sepals pale rose, more often unspotted; petals rubescent, sprinkled with violet spots, foveola black-purple.

"Genus midway between Lilium and Fritillaria; truly related to Lilium by the nature of the bulb, dorsifixed anthers,

genere affini observatum; perianthii lobis exterioribus et interioribus dissimilibus, omnibus late patentibus.

N. pardanthina.—Yun-nan, in pascuis montis Koua-la-po, supra Hokiu; fl. 2 jun. 1883 (Delavay, no. 257).

Le tubercle est formé d'écailles étroites, charnues, comme celui de certain Lis; dans les individus grêles les feuilles sont ordinairement éparses et la fleur solitaire. Les individus robustes, atteignant jusqu'à cm. 60, ont presque toujours les feuilles verticillées par 4-6, sauf les inférieures et les supérieures, et ils ont jusqu'à 4 fleurs larges de 6-8 cent.; ces fleurs sont très ouvertes; leur divisions étalées horizontalement présentent la particularité singulière d'être nettement dissemblables. Les 3 externes ovales, entières sur les bords, sont le plus souvent dépourvues de macules violacées; les 3 intérieures largement ovales, à bords dentés-fimbriés, parsemées de taches d'un pourpre brun, offrent en outre à leur base une large macule d'un pourpre foncé en partie recouverte par une écaille flabelliforme qui est libre dans sa moitié supérieure et divisée jusqu'au milieu en 5-8 lobes étroits, élargis et lobulés au sommet.

Les filets staminaux sont très remarquables par le renflement de leur portion inférieure, obovale-claviforme, creuse et à parois très minces, arrondie au sommet et surmontée par une pointe subulée qui porte l'anthère insérée par le milieu du dos.

Cette charmante Liliacée, qu'on peut espérer voir cultiver un jour, fait l'ornement des pâturages à sol calcaire de la montagne de Koua-la-po, dans le district de Tali, où elle végète parmi les herbes, à la manière des Lis.

and the style; inclining to Fritillaria by the foveolate petals. From both genera it differs by: the hollow inflated lower part of staminal filaments; the much-cleft and half-free foveola, which is seen in no allied genus; the dissimilar outer and inner lobes of the perianth, which are all widely spreading.

"*N. pardanthina*, Franch.

"Yunnan:—In pastures of Mt. Koua-la-po, above Hokin; fl. 2 Jun. 1883 (Delavay, No. 257).

"The tubercle is formed of straight, fleshy scales like those of certain lilies; in weak individuals the leaves are ordinarily scattered and the flower solitary. Robust individuals reach as much as 60 cm. in height, have the leaves almost always in whorls of 4–6, excepting the lower and upper ones, and have as many as 4 broad flowers of 6–8 centimeters; these flowers are very open; their divisions stretched out horizontally present the singular feature of being markedly dissimilar. The 3 outside ones are oval, entire, and more often without violet spots; the 3 inside ones, broadly oval, toothed and fimbriate, and sprinkled with purple-brown spots, have at their base a large blotch of a deep purple colour in part covered by a fan-shaped scale which is free in its upper half, and divided as far as the middle into 5–8 lobes expanded and lobulate at the top.

"The staminal filaments are very remarkable by the voluminous expansion of their lower portion, which is oboval-club-shaped, hollow with thin walls, rounded at the summit and surmounted by a subulate point which bears the anther inserted by the middle of its back.

"This charming liliaceous plant, which one may hope to see in cultivation one day, is an ornament of the pastures on the calcareous soil of Mount Koua-la-po in the district of Tali, where it grows amongst herbs after the fashion of a lily."

Franchet's expectation has been realised. *N. pardanthina* flowered in the Royal Botanic Garden, Edinburgh, in 1914, in plants raised from seeds collected by George Forrest (No. 5816) for Bees Ltd., some of which were generously presented to us. The plant was exhibited on 6th June 1916

at the Royal Horticultural Society, where it was awarded a First Class Certificate. It is a beautiful plant, and well worthy of cultivation for itself. If it takes in hybridisation, it should originate a remarkable race of garden plants. The habit certainly suggests Lilium rather than Fritillaria. How far that is borne out by analysis and comparative investigation will be set forth in what follows here.

Before passing to this, I must say something of other known forms of Nomocharis.

Shortly before our plant of 1914, which had rose-coloured flowers, opened its blooms, a plant of the genus Nomocharis, raised from seeds also collected by George Forrest, flowered at Edinburgh in one example only, producing a large open flower with a white ground spotted maroon all over both sepaline and petaline segments, recalling, indeed, the colouring of the more spotted varieties of *Odontoglossum crispum*. In addition, the petaline segments at base were blotched a deep purple-red. From this flower we were fortunate in obtaining seeds—most fortunate, indeed, because by one of these accidents to which in these days we are particularly liable our old plants, both of it and of *N. pardanthina*, were destroyed. In Forrest's dried collections there are specimens of this Nomocharis with white and spotted flowers under Nos. 3845, 7160, and 11,624, the flower in 7160 being by far the finest. On his field-tickets Forrest describes the flowers as "satiny white" or "watery white" and spotted, and he also says they are fragrant. (Amongst his specimens is also one under No. 3844, of which he writes, "variety with flowers pure white," and the solitary flower bears out the description, showing no spots.) Without doubt a Nomocharis, this plant seems to be a different species from Franchet's *N. pardanthina*, and the description which I give of it here under the name *N. leucantha* tells the difference between them.

N. leucantha, Balf. f.[1]

Bulb scaly narrowly ovate pointed about 3 cm. long and 1·5 cm. in diameter. At flowering time coated outside with

[1] *Nomocharis leucantha*, Balf. f.—Bulbus anguste ovato-oblongus, squamis carnosis acuminatis. Caulis ad 75 cm. altus. Folia ad medium 3–6-verticillata infra et supra per paria disposita, infima sparsa, lanceo-

mucilaginously rotting remains of 3-year-old and older scales; chief scales of the bulb 5–6 2-year-old fleshy straw-coloured ovate tapering to a membranous erose decapitated summit adpressed connivent more or less surrounding withered base of stem of their year and enclosing flowering stem enwrapped in shorter 5–6 scales of the year which have fleshy bases and membranous top acute or obtuse. Roots somewhat fleshy. Stem as much as 75 cm. long and 5 mm. in diameter below first green leaves, above the bulb tuftedly rooting after fashion of lilies, bare of green leaves below over as much as 28 cm. and bearing there one or two sparse distant strap-shaped blunt mucronate scale-leaves. Green leaves in distant (often 7·5 cm.) whorls of 3–6 after a first solitary leaf often followed by a pair, at summit sometimes in pairs, lanceolate or rarely lower ones oval-lanceolate long-acuminate with a sharp point, as much as 9·5 cm. long 2·4 cm. broad, conspicuously 3-nerved with subsidiary intermediate parallel nerves, olive-green above, beneath paler somewhat glaucous. Flowers 2–3 distant racemose axillary to one leaf of uppermost whorls, pedicels stiff straight, at apex thickened and there nodding, slightly shorter than axillant leaf, spreading nearly horizontal. Perianth open spreading as much as 9 cm. in diameter; segments "watery" or satiny white all equal in length and spotted palé purple or crimson-maroon, petaline with deep purple-red 2-lobed basal blotch about 6 mm. long; sepaline segments with small median basal purple blotch and faint midrib eglandular, ovate as much as a little over 4 cm. long about 2 cm. broad, shortly acuminate ending in darker sometimes swollen tip, acuminate apex ciliate-fringed rest of margin entire eciliate; petaline nearly orbicular with prominent midrib as much as 3·5 cm. broad abruptly

lata longe acuminata ad 9·5 cm. longa 2·4 cm. lata papyracea, supra atroviridia subtus glauca. Flores distantes in racemum 2–3-florum laxe dispositi; pedicelli stricti patentes apice nutantes. Perianthum aperte patens ad 9 cm. diam. albidum nitens maculis pallide-purpureis vel kermesinis et varo rufescente basali notatum; segmenta inaequalia dissimilia, calycina eglandulosa ad 4 cm. longa 2 cm. lata breviter acuminata, apice obscure fimbriata, petalina suborbicularia ad 3·5 cm. lata abrupte acuminata, costa media prominula, margine superne dentato-fimbriata, basi biglandulosa glandula quaque labio inciso flabelliformi cristata. Stamina circ. 1·6 cm. longa ovarium subaequantia; filamenti pars inflata ad 9 mm. longa, apex subulatus ad 3 mm. longus; antherae circ. 8 mm. longae ad 3 mm. supra basin dorsifixae.

acuminate at summit and there ciliate-fringed, downwards through one half or more dentate-fringed, entire below, base with two nectar-glands one on each side of midrib, each covered by a fan-shaped incised or crested dark purple-red flap. Stamens about 1·6 cm. long; swollen base of filament deep purple about 9 mm. long, subulate apex about 3 mm. long; anther about 8 mm. long shortly apiculate, dorsifixed about 3 mm. from base. Gynaeceum about 1·7 cm. long; ovary oblong wider towards top: style clavate below the trumpet-shaped 3-lobed stigma.

Mid. W. Yunnan:—Tali Range. Eastern flank. Grassy situations on the margins of pine forests. Alt. 11,000–12,000 ft. Lat. 25° 40′ N. Plant of 18–24 ins. Flowers watery white, blotched and spotted pale purple, base of perianth deep purplish-maroon, faintly fragrant. G. Forrest. No. 3845. June 1906.

Mid. W. Yunnan:—Tali Range. Eastern flank. Pasture on the margins of pine forests. Alt. 12,000–13,000 ft. Lat. 25° 40′ N. Plant of 18–30 ins. Flowers satiny white spotted crimson-maroon. G. Forrest. No. 7160. Sept. 1910.

Mid. W. Yunnan:—Tali Range. Alt. 11,000 ft. Lat. 25° 40′ N. G. Forrest. No. 11,624. Aug. 1913. Dup. of 1906-1910.

The chief points of difference between this species and *N. pardanthina* are:—a more robust and taller plant; the much longer and broader long-acuminate leaves; the white flowers with all the segments spotted purple or maroon.

This Forrestian species conforms well with the characters of Nomocharis as given first of all by Franchet. It is otherwise with a species placed in the genus by Franchet in 1898 with the name *N. meleagrina*. I have not seen *N. meleagrina*, Franch., and can only give here Franchet's account of it.

N. meleagrina, Franch. in Journ. de Bot. xii (1898), 196.[1]

"Many feet high. Leaves linear lanceolate long-acuminate, upper sparse (middle and lower wanting).

[1] Franchet's description runs:—
Nomocharis meleagrina.—Pluripedalis; folia lineari-lanceolata, longe acuminata, superiora sparsa (inferiora et media desunt); flores axillares,

Flowers axillary long-pedicellate; pedicel 15 cm. long arcuate-patent equalling or exceeding the leaves. Perianth rose with equally and densely distributed broadish red-fuscous spots on all the segments, 7–9 cm. in diameter widely open, almost plane; calycine segments quite entire ovate lanceolate acute or shortly acuminate; petaline segments scarcely broader than calycine and equalling them in length, sparingly and subtly erose above; crest of the basilar nectar-gland deep red-fuscous, fan-shaped, variously incised. Stamens one-fifth the length of perianth. Style as long as ovary; stigma globose obscurely lobed.

"N.W. Yunnan:—Mt. Sela, banks of the Mekong. R. P. Soulié. No. 1032."

By description and by Franchet's comments we can recognise that this *N. meleagrina* is markedly different from *N. pardanthina* in the much larger leaves, apparently 15 cm. long, which are not whorled in upper part of the stem; long pedicels as long as the leaves; larger flowers; perianth-segments equal in length and breadth; all the perianth-segments equally and densely spotted; faint erosion only of upper part of petaline segments; stamens only one-fifth of length of perianth. It is clearly also not the same as *N. leucantha*.

Of its characters, that which is of importance as a criticism of the generic characters founded upon *N. pardanthina* is the slight dissimilarity of the sepaline and petaline segments:—they are similarly spotted, of equal length and breadth, and the petaline segments are scarcely erose on the margin above.

longe pedunculati, pedunculis 15 cent. longi, arcuato-patentibus, folia aequantibus vel superantibus; perianthium (diam. 7–9 cent.) late apertum, fere planum, roseum cum maculis latiusculis, rubro-fuscis, in omnibus foliolis aeque ac dense distributis; foliola calycina integerrima ovato-lanceolata, acuta vel breve acuminata; foliola corollina calycinis vix latiora, illis aequilonga, superne parce et subtiliter erosa; cristae basilares intense rubro-fuscae, flabelliformes, varie incisae; stamina perianthio 5-plo breviora; stylus ovarii longitudine, stigmate obscure lobato, globoso.

Hab.—La Chine occidentale: province de Se-tchuen, sur les montagnes de Sela, sur les bords du Mekong (R. P. Soulié, n. 1032).

Diffère du *N. pardanthina* par ses feuilles plus grandes, éparses, et surtout par son perianthe dont les divisions sont égales et toutes couvertes de taches brunes, les trois intérieures à peine érodées sur les bords. Dans le *N. pardanthina*, les trois divisions intérieures sont presque arrondies, incisées-érodées dans leur moitié supérieure.

One other plant has been put in Nomocharis. Léveillé in 1913 published the name *Nomocharis Mairei*. Of this species all that Léveillé says is:—[1]

"Scarcely 2 ft. high. Separated from *N. meleagrina* by its ovate leaves verticillate excepting the lower which are opposite; white terminal flowers; clavate stigma. Distinguished from *N. pardanthina* by its broad leaves and abruptly acuminate corolline segments.

"Yunnan:—Pastures of the plateau of Ta-hai, 3200 m., fl. white spotted black (internal divisions). E. E. Maire. July 1912."

We have at Edinburgh specimens (No. 269, Herb. Edin.) obtained from Abbé Maire in 1913 bearing the same ticket, and it is without doubt the plant which Léveillé has named. Ta-hai is in N.E. Yunnan, about long. 103° 10′ and lat. 26° 55′. In addition, we have the same plant in specimens (No. 107, Herb. Edin.) obtained from Abbé Maire, also in 1913,—labelled "Pastures of the summits at Pé-long-tsin. Alt. 3200 m., fl. white. E. E. Maire. July"—from the same region. I believe I know, therefore, what Léveillé had before him.

Maire's specimens do not fit Franchet's description of *N. meleagrina*. Prominent and valid differences are the shorter leaves, not long-acuminate; the much shorter flower-pedicels, not 4 cm. long—they are 15 cm. in *N. meleagrina*: the smaller white flowers with dissimilar sepaline and petaline segments; the toothed and fringed petals.

The two characters — broader leaves and abruptly acuminate corolla segments—by which Léveillé separates *N. Mairei* from *N. pardanthina* would not alone, if they existed, suffice as specific marks. As matter of fact, the petals of *N. pardanthina* are as abruptly acuminate as are those in Maire's plant, and the difference in leaf-width seems to be hardly appreciable. Maire's plant is not *N. pardanthina*, but Léveillé has not got hold of the dis-

[1] Léveillé in Fedde Repert. xii (1913), 287:—

Nomocharis Mairei.—Vix bipedalis. A *N. meleagrina* folia ovata, inferioribus oppositis exceptis, verticillata; flores albi terminales; stigma clavatum illam plantam secernunt. A *N. pardanthina* foliis latis et foliolis corollinis abrupte acuminatis dignoscitur.

Yun-Nan: Pâturages du plateau de Ta-Hai. 3200 m., fl. blanches mouchetées de noir (divisions internes), juill. 1912 (E. E. Maire).

tinctive characters. The plant is much more like *N. leucantha*. Indeed, in flower it is somewhat of a miniature form of that species. It differs from it, however, in foliage and other points, and is probably the N.E. Yunnan representative of this Mid. West Yunnan species. The following is a description of the plant based upon Maire's specimens in the Edinburgh Herbarium:—

Nomocharis Mairei, Lévl. in Fedde Repert. xii (1913), 287 (revised character).

Stem as much as 35 cm. high with short internodes about 3 cm. long fairly stout about 4 mm. in diameter below the foliage-leaves. Foliage-leaves in whorls of 3–5 over the stem, below one or two single at the node followed by a pair, coriaceous ovate-lanceolate shortly acuminate, lower ones sometimes elliptic-ovate or ovate and obtuse, about 3·5–4 cm. long (lower ones a little shorter), 1·3 cm. broad (lower ones sometimes nearly 2 cm.). Flowers terminal solitary or in a 2-flowered raceme white with purple spots on petaline segments, rufescently blotched at base, pedicel stout ascending or erect straight to slightly deflexed tip, about equal in length to leaves. Perianth widely open almost flat as much as 5·5 cm. across; segments dissimilar more or less abruptly acuminate, tip obscurely fringed; calycine oval about 3 cm. long 1·5 cm. broad unspotted but with a small dark blotch at base, eglandular; petaline broadly ovate or rounded about 3 cm. long 2·5 cm. broad, margin from below middle toothed fringed, below entire, midrib prominent, with a bilobed basal gland, one lobe on each side of midrib, each lobe bearing a fan-shaped much incised fringed lip. Stamens about 1·2 cm. long; inflated lower part of filament about 6·5 mm. long about equalling ovary, subulate portion about 3 mm. long; anther barely 5 mm. long, dorsifixed about 1·5 mm. above base, shortly apiculate.

N.E. Yunnan:—Pastures of the plateau of Ta-hai. Alt. 3200 m. Flowers white spotted black. E. E. Maire. July. Herb. Edin. No. 269/1913.

N.E. Yunnan:—Pastures of the summits at Pé-long-tsin. Alt. 3200 m. Flowers white. E. E. Maire. July. Herb. Edin. No. 107/1913.

This plant resembles in white flowers with dark spotting *N. leucantha* rather than *N. pardanthina*, which has rose-coloured flowers. It is altogether a smaller plant than *N. leucantha*, has thicker leaves, more close-set, and without the long delicate acuminate tips we find in *N. leucantha*. The flowers, too, are much smaller. Most of the specimens show solitary terminal flowers, but one has a ripening ovary of a second flower below the terminal one.

All these plants which have been named Nomocharis are without doubt rightly placed in it. Whether specific rank can be maintained for all of them is a question that can only be answered with certainty when we know more about them. That the *N. pardanthina* and *N. leucantha* of cultivation are different species seems to me on the evidence to be unquestionable. *N. meleagrina* reads also distinct. *N. Mairei* is the doubtful species looking to *N. pardanthina* in foliage, to *N. leucantha* in flower characters. It is an outlier from the distribution of the other species. These are Mid. Western and W.N.Western Yunnan plants. It is from N.E. Yunnan, and we know that the plants of this area are, as a whole, different from, if nearly allied to, those of Western Yunnan. At the same time we are prepared in dealing with tuber-forming plants to find areas of specific distribution much wider than those of other plants. Prolonged hypogaeous life removes the plant—and the deeper the more effectively—from the influence of factors which act upon and bring about modifications in forms that have prolonged epigaeous life, and the greater constancy in conditions of life encourages greater constancy in form. The specific isolation which is so marked a phenomenon in the flora of the mountainous regions of Western China—see, for example, the genera Primula and Rhododendron—may quite well be less conspicuous in such a genus as Nomocharis, and the geographical distribution of *N. Mairei* cannot be regarded therefore as a point of much weight in relation to the question of its identity with species from farther west.

I turn now to the question of the position of Nomocharis as a genus. The leading characters of diagnosis may be stated thus:—

(*a*) Squamate bulb.
(*b*) Open perianth.
(*c*) Dissimilar sepaline and petaline perianth-segments.
(*d*) Fringed basal foveola on petaline segments only.
(*e*) Swollen lower portion of staminal filament.
(*f*) Dorsifixed anthers.
(*g*) Style.

Taken by themselves in relation to those of Lilium and Fritillaria these characters seem to be decisive as differential generic marks. But, as is well known, the limit between Lilium and Fritillaria is difficult to define—if it really exists. On the one hand, there are the Notholirions, excluded from Lilium by Baker[1] and by Elwes, but included by Bentham and Hooker;[2] on the other hand, the Liliorhizae, which have been shuttled also from one genus to the other, are now placed in Fritillaria by Bentham and Hooker.[3] Into both we have yet to see much more clearly before phyletic claims are established. A recent illustration of the difficulty which botanists have experienced in assorting forms is seen in the Szechwan plant which Franchet[4] first of all named *Fritillaria lophophora*, suggesting at the same time that it might constitute under the name Lophophora a particular section of the genus. Subsequently Franchet transferred the species to Lilium as *Lilium lophophorum*.[5] Now, in the light of further discoveries, it may be a question whether the place of this plant is in one of these genera, or is in Nomocharis, or in a new genus intermediate to Lilium and Fritillaria. After all, so far as nomenclature is concerned, it is a matter of convenience, seeing that our genera are only temporary expressions of reaction of a phyletic line, and what we have to strive after is a grouping and naming which shall best give us a picture of phyletic relations as they appear to us.

In order to obtain data for determining the best disposal of the forms brought together under Nomocharis I will now touch in succession upon the differential characters of the genus:—

[1] Baker in Journ. Linn. Soc., xiv (1875), 268.
[2] Bentham et Hooker, Gen. Plant., iii (1883), 817.
[3] Ibid., Gen. Plant., iii (1883), 818.
[4] Franchet in Journ. de Bot., v (1891), 153.
[5] Ibid., xii (1898), 221.

The Scaly Bulb.—The elongated bulb with more or less ovate-lanceolate pointed scale-leaves of Nomocharis is very different in form from the short somewhat globose bulb with rounded tuberous scale-leaves of typical Fritillaria. It approaches somewhat the form found in Lilium, particularly that of *L. polyphyllum* as represented by Elwes.[1] It is not confined to Nomocharis outside Lilium. In 1839 Royle[2] briefly described under the name *Fritillaria oxypetala* a W. Himalayan plant which, like as it is in some features to the Fritillarias of previous descriptions, differs in certain obvious characters, and of these the bulb-form is one. The bulb if not quite the same as that of Nomocharis —there are many more and narrower shorter scales which are not so connivent at the top but more open—is yet cast on the same mould and is very different from what is found in Eufritillaria. Baker[3] recognised the difference, and taking the bulb to be more lilioid than fritillarioid, he renamed the plant *Lilium oxypetalum*, Baker. Under this name Elwes[4] figured the plant. Sir Joseph Hooker[5] brings back the plant into Fritillaria and differentiates a new species, *F. Stracheyi*, Hook. f. (W. Himalaya), with the same form of bulb. This same form of bulb we meet with also in *Fritillaria lophophora*, Franch.[6] (N.E. Yunnan and W. Szechwan). *F. flavida*, Rendle[7] (S.W. Tibet), Ward sp. No. 758[8] (S.E. Tibet), Ward sp. Nos. 741, 813[9] (S.E. Tibet). In what follows I shall use the term Oxypetala for this group of fritillaries from the N.W. and W. Himalaya, S.E. Tibet, and W. China, which in their bulb-form are like Nomocharis—so like, indeed, as to negate the value of the bulb-form as a differential character of that genus.

I must not omit to mention a character of the stem in Nomocharis which may have phyletic significance. In all the species I have seen the stem shortly above the bulb

[1] Elwes, Monogr. Lil. (1880), t. 48.
[2] Royle, Illustr. Bot. Himal., i (1839), 388.
[3] Baker in Journ. Linn. Soc., xiv (1875), 234.
[4] Elwes, Monogr. Lil. (1880), t. 5.
[5] Hook. f., Fl. Brit. Ind., vi (1892), 352.
[6] Franchet in Journ. de Bot., v (1891), 153.
[7] Rendle in Journ. of Bot., xliv (1906), 45.
[8] Probably a new species of Nomocharis of the Oxypetala series (see p. 291).
[9] Named *Nomocharis Wardii* on p. 297.

emits profusely lateral rootlets after the fashion of Lilium. I do not find this in the series Oxypetala. Does this mean that the bulb of Nomocharis lives in a shallower stratum of the soil than does Fritillaria?

The Open Perianth.—The open perianth of Nomocharis is one of its most striking features. The flower is as open as that of Meconopsis, and there may be even a slight reflexing from the base but never the recurving of Lilium. In no Fritillaria is there anything quite like it. At the same time, in the Oxypetala series we find the perianth not showing the typical campanulate form of Fritillaria. That may be a consequence of the absence of the median petaline foveola. The corolla is broadly funnel-shaped or concave, and in *F. oxypetala* is really open.[1] The character cannot be regarded as one defining Nomocharis in Franchet's sense. It appears in some other divergent forms collected by Forrest, Nos. 493, 10,620, and by Ward, No. 801, on the Burmo-Chinese frontier to fix the generic position which has led to my making this incursion into the field of Lilium and Fritillaria.

Dissimilarity of Sepaline and Petaline Segments.—In *N. pardanthina*, upon which Franchet founded Nomocharis, the contrast in form between sepals and petals is remarkable. The spotted petals are broad, nearly orbicular, with an abruptly acuminate tip, and the midrib is a relatively broad prominent ridge. The margin in about the upper half is more or less fringed, and the acuminate tip has a series of marginal outgrowths miniature of the fringe-segments of the broader part of the petal. As they lie in the expanded open flower they are cochlear imbricate and conceal the sepals save where the sepaline tips show in the corolline sinuses. The unspotted sepals, on the other hand, are ovate acute rather than acuminate, about the same length but only a little more than half as broad, and whilst they have the same reduced marginal outgrowths along their tips, want entirely the fringe of the margin of the broader portion.

The same contrast appears in *N. leucantha* and *N. Mairei*. But in *N. meleagrina* the petals and sepals are said to be all alike spotted, ovate-lanceolate, equally long and broad,

[1] See Bot. Mag. (1853), t. 4731, and Elwes, Monogr. Lil. (1880), t. 5.

and the dissimilarity is reduced to a trace of erosion of the margins of the petals in contrast with the quite entire margins of the sepals.

It would appear, then, that difference in size, shape, and spotting, between sepals and petals, is practically discarded as a generic character of Nomocharis.

In support of this we find in the Oxypetala series fluctuations in respect of these characters, and whilst all of them have upon the pointed tips of all the perianth-segments the reduced marginal outgrowths mentioned above as appearing in Nomocharis, in one,—*F. lophophora*—as Franchet himself points out, the base of the petaline segments is always minutely fringed.

Fringed Basal Foveola on Petaline Segments.—This character is made much of by Franchet, and he says it is seen in no allied genus. It requires therefore particular investigation.

The dice-box form of perianth that gives the name to Fritillaria is in great measure a consequence of the development in the middle line of each perianth-segment of a glandular area, long or short, forming a shallow pit or a deeper pit (foveola) with its long axis coincident with that of the segments. It occurs higher up or lower down on the segments, always below its middle, and gives a bulge outwards to the segments at the point where it occurs, its tissue being firmer, more fleshy, and usually darker coloured than the adjacent matrix of the segment. The surface of this area is coated with short projections—the excreting agents. This glandular area occurs on every perianth-segment. In the section Rhinopetalum of Fritillaria the bulge it forms is emphasised, and I take it gave origin to the sectional name. In the section Petilium—in so many features different from Eufritillaria—the form of the gland is nearly circular and it is basal but its position central on the perianth-segments. Now in Nomocharis the construction is different:—

(*a*) The sepaline segments have no glandular area. That is restricted to the three petaline segments.

(*b*) The glandular area is not in the middle line of the segment.

(*c*) The middle line is occupied by a strong midrib pro-

jecting on the upper surface of the segment and separating distinctly a left side of its lamina from a right side of its lamina at the base.

(*d*) The glandular area is at the base of the segment, and owing to the projection of the midrib it is divided into a left half and a right half, or, if you will, there are two glandular areas, a left-side one and a right-side one, and these are separated by the nonglandular midrib.

(*e*) Each of these dark-coloured glandular areas has arising from it a correspondingly dark-coloured flap ascending fan-ways and deeply incised, fringe-fashion, and the fringe-lobes are covered with excreting gland-cells. From dried specimens—and these are all I have been able to use for this analysis—it is not easy to be sure of minute anatomical details, and I cannot say to what extent each flap converts its glandular area into a pocket-gland, such as that which we meet with in Ranunculus; nor can I say whether the gland-area beneath the flap has excretory cells—certain is it the fringe-lobes of the flap are really glandular.

It is this spreading flap—crista basilaris—which has attracted most attention as a differential character, so far as gland-structure is concerned, in Nomocharis; but, after all, it is only a concentration of the excreting cells which in Eufritillaria are distributed more or less over the whole area. What is previous to it is the division of the glandular area into lateral halves separated by a raised midrib and the restriction of the glandular area to the petaline segments.

Were this construction peculiar to Nomocharis it might be taken as a strong generic character. But it is not so. In the whole series of Oxypetala (I except for the moment *F. flavida*, which I have not seen) we find a basal glandular area on the petaline segments only, a prominent midrib separating the glandular area into two divisions—a right and a left—the glandular area crested. In the cresting there are just such differences, so far as I can determine in dried specimens, as prevent our saying that it is that of Nomocharis. The somewhat regular fan-like expansion of a fringed flap is absent, and the cresting is distributed over the surface, extending sometimes upwards along each side of the raised midrib. But these are, if anything, details of

only specific value in themselves. Morphologically and physiologically the construction is the same. Its occurrence in the series Oxypetala detracts from its value as differential of Nomocharis. It is not a solitary character distinguishing the series Oxypetala. I have pointed out that in bulb-form also these series agree, and the individual differences of their other flower characters—none of them—negate near natural relationship. The series is markedly divergent from the type of Fritillaria. It is further away from Lilium. It touches Nomocharis at several points.

I have yet more to say about this character. The dual basal glandular area confined to the petaline segments has not always the crested form seen in Nomocharis and the Oxypetala series:—

In the Forrestian plant, No. 10,620,[1] from E.N.W. Yunnan, the gland-construction of Nomocharis is repeated with this sole difference—the flap is not fringed.

Another Forrestian plant, No. 493,[2] from the Mekong-Salween divide, shows the petaline dual basal gland separated by midrib with flaps which are not fringed and are much smaller than in Forrest's No. 10,620.

In a plant collected by Kingdon Ward in S.E. Tibet, under No. 801,[3] there is the petaline dual basal glandular area separated by midrib, but each of the areas is most minute with mere trace of flap and without fringe.

Here, then, we have three plants from W. China which have the petaline dual gland-character of Nomocharis and the Oxypetala series but without the cresting. They are not yet described. They have scaly bulbs, perianth-segments more or less equal, more or less spreading, stamens, as we shall see immediately, with slightly inflated filaments. What is their position?

Androecium.—Of all the characters of his genus Nomocharis given by Franchet that of the stamens is the most individual. The filament, which is about 12 mm. long, shows in each of the six stamens two distinct areas. A lower, some 10 mm. or so long, which is swollen into a club-shape, or one might compare it with that of a jargonelle pear. It

[1] Named *Nomocharis Forrestii* on p. 293.
[2] Named *Nomocharis salwinensis* on p. 294.
[3] Named *Nomocharis tricolor* on p. 296.

is as much as 2 mm. in diameter. From the centre of its convex summit there arises abruptly, like an elongated apiculus, a thin needle-like upper portion some 2 mm. long, which is attached by its sharp point to the connective of the anther slightly below the middle. The anther is distinctly dorsifixed. This upper portion of the filament is pale-yellow coloured, in contrast with the dark-coloured, brown or purple lower swollen portion. This lower portion gives the impression of being a hollow sac. It is not really a sac. Through the centre of it runs the vascular bundle, and it is surrounded by a cellular tissue with large intercellular spaces enclosed by some peripheral layers of more compact cells. The large anther, some 7 mm. long swinging on the top of the needle-like upper filament, perched on top of the fat lower filament, is most distinctive. It is a strong character in support of Nomocharis as a genus, for it is known nowhere else within this group of forms.

Nevertheless, we are not without approaching forms. They are to be found in the Forrestian plant No. 10,620 and the Wardian plant No. 801 previously mentioned. In them the staminal filaments are swollen in a longer, lower, dark-coloured portion, needle-like in an upper pale-coloured portion, to which the anther is dorsifixed. But the inflation of the lower portion is not nearly so great as in Nomocharis —to not quite 1 mm.—and then this lower part does not end in a convex broad top in the centre of which stands the needle-like extension, but narrows into the subulate tip. The areas from which these plants have come to us are not yet fully explored botanically, and these forms suggest that other species more closely linking with Nomocharis in this staminal character may yet be discovered.

The dorsifixed anther of Nomocharis seems to be a liliod character of little value for separating it from Fritillaria. True basifixed anthers I know of in *Fritillaria* (Petilium) *imperialis*, but in all the forms of Fritillaria I have cited here the anthers are attached by the back of the connective a short distance at least above their base and always to a finely pointed tip of the filament. It is not merely a case of intrusion of the filament between the prolonged bases of the antherine lobes. Whether in nature the anthers are really versatile, dried specimens do not suffice to determine.

Certainly in the cases of which I am speaking the anthers swing readily on the tips of the filaments after soaking in water, and the somewhat open corolla may allow of this in nature.

Style.—There is nothing distinctive in the style of Nomocharis. As in the series of Oxypetala and in those undescribed plants from West China of which I have spoken, it is clavate, usually about the same length longer or shorter than the ovary, and the apex is trumpet-shaped with the stigmatic margin more or less 3-lobed. The style of all of them is very different from the trifid style of so many of the species placed in Fritillaria.

It is clear, in the light of our increased knowledge, that the position of Nomocharis is not so isolated as the characters given by Franchet, drawn from the material at his disposal, indicate. The only character which is peculiar to all the species of Nomocharis hitherto described is that of the rounded summit to the swollen lower part of the staminal filament whence an apiculate subulate continuation proceeds. All the other characters appear, or grade into those found, in other plants described or undescribed, as I have endeavoured to show. The question we have to ask and to answer is—Can Nomocharis be maintained as a distinct genus? In my opinion it should be maintained but with an extended horizon, and I shall best make clear the grounds of this opinion if I bring together here, in what appears to me to be their natural systematic grouping, the various species, to which I have referred in preceding pages, showing relationship to Nomocharis. The species that come into consideration are:—*Fritillaria flavida, lophophora, oxypetala, Stracheyi*; undescribed, Ward sp. No. 758, Ward sp. Nos. 741, 813; *Nomocharis leucantha, Mairei, meleagrina, pardanthina*; undescribed, Forrest sp. No. 493, Forrest sp. No. 10,620, Ward sp. No. 801.

They all agree in these characters:—

Scaly bulb with elongated ovate-lanceolate or lanceolate fleshy scale-leaves. Perianth-segments always obscurely fringed at the tip. Petaline segments only possessing basal gland divided into two by prominent midrib. Anthers dorsifixed. Style clavate short about equal to ovary, trumpet-shaped at end with three-lobed stigma.

They fall into three series, to which I have given names :—

1. *Oxypetala.*—Bulb small with many narrow not connivent scale-leaves. Stem one-flowered not rooting above bulb. Foliage-leaves linear sparse. Perianth funnel-shaped or concave. Perianth-segments equal or slightly unequal, rarely petals fringed at base. Petaline glands crested all over. Staminal filaments not inflated.

   Here belong : — *Fritillaria flavida, lophophora, oxypetala, Stracheyi*; undescribed, Ward sp. No. 758, Ward sp. Nos. 741, 813.

2. *Eunomocharis.*—Bulb larger with few ovate lanceolate fleshy scale-leaves. Stem racemosely flowered rooting above bulb. Foliage-leaves oval-lanceolate or lanceolate, whorled, sparse below and sometimes above. Perianth open, often flat. Perianth-segments usually dissimilar, petals broadest, usually dentate-fringed above middle or erose. Petaline glands with fan-shaped, fringed lap. Staminal filaments pyriform, much inflated, convex at top with much shorter subulate tip springing from centre.

   Here belong :—*Nomocharis leucantha, Mairei, meleagrina, pardanthina.*

3. *Ecristata.*—Bulb larger with many fleshy lanceolate scale-leaves. Stem racemosely flowered or with 1 terminal flower, rooting above bulb. Foliage-leaves lanceolate sparse or in pairs. Perianth more or less open. Perianth-segments subequal entire below tip. Petaline glands with a flap not fringed. Staminal filaments slightly inflated, tapering into much shorter subulate tip.

   Here belong :—Undescribed, Forrest sp. No. 493, Forrest sp. No. 10,620, Ward sp. No. 801.

The whole of them approach Lilium in their bulb. They diverge in the petaline glands. If anyone be bold enough to combine in one genus Lilium and Fritillaria, then all these forms would also go into the new combination. But I do not see what advantage would be gained by such an aggregation, either as giving a phyletic picture or as a statement of observed facts.

From Fritillaria—to which in outward appearance the first series in particular shows great resemblance—they diverge in the bulb form, the more or less open perianth, and the petaline glands.

To refer all these forms to Fritillaria—an obvious suggestion — notwithstanding the difference, would be to ignore, I think, evident phyletic developments which have gone quite as far in a divergent direction from Fritillaria as to warrant segregation of the forms presenting them in a named genus. If we were to include them in Fritillaria they would claim the position of a subgenus. Certainly, as generic characters go in Liliaceae, the characters which

I have given above as the possession of all these plants seem to me to be adequate for the diagnosis of one, and what I am tempted to do is to use these characters as the differentiating ones of Nomocharis, taking the three series arranged above as sections of it, naming them, 1. Oxypetala; 2. Eunomocharis: 3, Ecristata. By this procedure we should emphasise the fact that we have a phyletic series that diverged from a common ancestry along with Fritillaria proper, and with that remarkable arrested branch which is conveniently placed because of lack of further evolution of its form in Fritillaria as *F. imperialis*. I have no difficulty about combining in one genus the forms of series 2 and 3 and about keeping it distinct from Fritillaria. I am more hesitant about the right treatment of series 1, for its members undoubtedly in habit—slender plants with stem not rooting above bulb, leaves long linear solitary at nodes, solitary terminal more or less drooping flower—recall strongly Fritillaria. But it would not be so natural an arrangement, it seems to me, to place series 1 in Fritillaria and to treat the other two series as Nomocharis. And so I decide to yield to temptation and to state the view that the best expression of our present knowledge of these forms of which I have been speaking is to widen the limits of Nomocharis to the extent of including them all within it, arranging them in the series with the names already given and distinguished by the characters mentioned.

The decision enables me to name the several species to which in previous pages I have referred under collector's numbers, and it requires me also to give a revised definition of the genus Nomocharis as follows:—

Nomocharis. (Revised Character.)

Perianth deciduous, more or less open; segments subequal or dissimilar, lanceolate or oval or almost orbicular more or less acuminate, obscurely fimbriate at apex elsewhere entire or variously fringed, more or less spreading; calycine eglandular; petaline with a double basal glandular area half on each side of midrib crested or fringed or not. Stamens 6 slightly adhering to base of perianth-segments or free; filaments flattened, thread-like

or swollen below and gradually or suddenly ending in a needle-like tip; anthers oblong dorsifixed, dehiscing longitudinally at the sides. Ovary sessile 3-locular, 3-angular, angles rounded; style clavate short about equalling ovary, trumpet-shaped at apex with 3-lobed marginal stigma. Bulb squamate, scales fleshy elongated, ovate-lanceolate acute or acuminate. Stem simple, leafy. Leaves alternate or whorled or both. Flowers showy, stalked, nodding, solitary terminal or distant—as many as 6—on long leafy racemes.

A genus of some thirteen species from the Himalayas and W. China.

Three sections of the genus may be recognised:—

1. *Oxypetala.*—Including *N. Wardii*, Ward sp. No. 758, and the species described under Fritillaria as *F. flavida*, *F. lophophora*, *F. oxypetala*, *F. Stracheyi.*
2. *Eunomocharis.*—Including *N. leucantha*, *N. Mairei*, *N. meleagrina*, *N. pardanthina.*
3. *Ecristata.*—Including *N. Forrestii*, *N. saluenensis*, *N. tricolor.*

The following are descriptions of new species:—

Nomocharis Forrestii, Balf. f.[1] (Sect. Ecristata.)

A tall growing glabrous plant reaching 1 m. or more. Bulb scaly elongated, scales fleshy ovate-lanceolate at first acuminate or acute, apex soon shrivelling and falling off. Stem stout about 8 mm. in diameter below foliage-leaves, rooting above the bulb. Foliage-leaves distant solitary at the nodes below the inflorescence, where they are paired, lanceolate long-acuminate as much as 7 cm. long 2 cm. broad, dark green above, glaucous beneath, conspicuously 3-veined with parallel subsidiary veins. Flowers large distant in a 6-flowered (or more) raceme with paired linear-lanceolate green leaves; pedicels stiff stout about 2 mm. in diameter horizontal deflexed at tips.

[1] *Nomocharis Forrestii*, Balf. f.—Bulbus squamatus elongatus. Caulis ad 1 m. vel ultra, supra bulbum radicans. Folia distantia, inferiora sparsa, superiora inter flores per paria verticillata, lanceolata longe acuminata ad 7 cm. longa 2 cm. lata. Flores in racemum 6-florum laxe dispositi; pedicelli horizontaliter patentes ad apicem deflexi. Perianthium late patens ad 10 cm. diam. pallide roseum nitens maculatum et basi kermesino-variculosum; segmenta ovalia vel ovalia-lanceolata accuminata, sub apice obscura fimbriato integra; calycina eglandulosa; petalina basi bifoveolata foveolae cujusque labio ecristato. Stamina 6 circ. 1·7 cm. longa; filamenta ovarium subaequantia, infra inflata, in apicem brevem subulatum attenuata; antherae infra medium dorsifixae.

Perianth widely open, about 10 cm. across nearly flat, satiny pale rose spotted and blotched deep crimson; segments of about the same length and width about 5 cm. long and 2·5 cm. broad more or less ovate or ovate-lanceolate, all entire and acuminate, the tip ciliate with club-shaped short white processes; sepaline segments without a basal nectar gland but always with a darker spot at the very base; petaline segments bearing a basal dark-coloured two-lobed nectariferous gland the large lobes separated by the prominent midrib, each lobe with a free rounded swollen not fringed or crested flap. Stamens about 1·7 cm. long; filaments about equal in length to ovary slightly flattened at very base, upwards dark-coloured and slightly swollen as much as 1 mm. in diameter to about 1 mm. below anther, pointed not rounded at top and passing gradually into a thin subulate paler portion attached to anther at about 2 mm. above its base; anther about 7 mm. long. Ovary about 1·2 cm. long oblong and widening upwards, about 3·5 mm. in diameter at top, 6-angled, 6-lobed at top, very finely shagreened; style slightly shorter than ovary about 1 cm. long clavate at top beneath the trumpet-shaped 3-lobed stigma.

E.N.W. Yunnan: — Mountains in the N.E. of the Yangtze bend. Open alpine pasture. Alt. 13,000 ft. Lat. 27° 45′ N. Plant of 2 ft. Flowers satiny pale rose, spotted and blotched deep crimson. G. Forrest. No. 10,620. July 1913.

In habit like *N. leucantha*, but a much taller plant and easily recognised by the nearly equal perianth-segments, the non-crested petaline glands, the less swollen filaments of the stamens not rounded at top of swollen portion.

Nomocharis saluenensis, Balf. f.[1] (Sect. Ecristata.)

Glabrous tall herb as much as 1 m. high. Roots thick fleshy. Bulb scaly oblong about 3 cm. long, scale-leaves

[1] *Nomocharis saluenensis*, Balf. f.—Planta ad 1 m. alta. Bulbus oblongus squamatus. Caulis crassiusculus internodis brevibus, supra bulbum radicans. Folia inferiora sparsa, superne per paria distributa lanceolata breviter acuminata, ad 7 cm. longa 2 cm. lata. Flores 3 racemosi lati; pedicelli folia aequantes, divaricati. Perianthium albido roseum maculatum patens ad 9 cm. diam.; segmenta sepalina oblongo-ovalia utrinque angustata subobtusa evariculosa eglandulosa; petalina paullo longiora et latiora subelliptica apice lata obtusa basi kermesino-

fleshy ovate-lanceolate acuminate the tip drying off. Stem stout about 6 mm. in diameter below the foliage-leaves, rooting above the bulb. Foliage-leaves solitary at the nodes below the inflorescence, truly lanceolate as much as 7 cm. long 2 cm. broad shortly acuminate, narrowed to the base and there contracted into a short and broad petiole some 5 mm. long and 4 mm. broad, conspicuously 3–5 veined with subsidiary parallel veinlets, apparently concolorous above and below. Inflorescence racemose 3-flowered, leaves on the inflorescence-axis in pairs; flowers large on a stout more or less nodding pedicel about same length as leaves. Perianth broad open approaching 9 cm. across, pale whitish rose with purplish rose spots on all segments more or less; sepaline segments oblong-oval narrowed to both ends most to the tip, narrowly obtuse ending in a conspicuous hydathodal mucro, 4·4 cm. long 2·2 cm. broad, unblotched at base, without a basal nectary; petaline segments slightly broader and shorter and overlapping the sepaline ones about 4 cm. long 2·4 cm. broad sub-elliptic narrowed to both ends broadly obtuse at apex, dark red-purple blotched at base and there provided with two cushion-like pocket-nectaries one on each side of midrib, flap of pocket not fringed nor crested. Stamens 6 about 1·4 cm. long; filaments about 1·1 cm. long flattened at the base then terete swollen dark-coloured to about 1 mm. from end, tip subulate 1 mm. long pale coloured; anther about 6 mm. long oblong thick dorsifixed about the middle. Gynaeceum about 1·2 cm. long; ovary about 7 mm. long shorter than filaments, 6-grooved the ridges between grooves rounded, 6-lobulate at summit, slightly wider at top, about 2·5 mm. in diameter; style clavate about 5 mm. long, shorter than ovary, trumpet-shaped at top with 3-lobed marginal stigmas.

N.W. Yunnan:—Mekong-Salween divide. Open moist situations. Alt. 9000–10,500 ft. Lat. 28° 12′ N. Plant of 2–3 ft. Flowers pale whitish rose marked purplish rose on interior. G. Forrest. No. 493. Sept. 1904.

This is one of the plants referred to *Lilium apertum* variculosa biglandulosa glandulae labio integro ecristato efimbriato crescentico. Stamina ad 1·4 cm. longa; filamenta ovario paullo longiora infra paullo inflata in apicem subulatum ad 1 mm. longum attenuata; antherae circ. medium dorsifixae.

var. *thibeticum*, Franch. in Plantae Forrestianae.[1] It is not the same as Forrest No. 457 referred to the same variety. No. 457 is not a Nomocharis, and I do not deal with it here, for the material is hardly adequate for critical decision upon its proper place. Forrest No. 493 is certainly not *Lilium apertum*, Franch. It may be the plant Franchet referred to *L. apertum* var. *thibeticum*, which from the diagnosis Franchet gives and in the light of present knowledge I doubt being a variety of his *L. apertum*. In default of actual specimens I cannot decide. Were there certainty, Franchet's varietal name might be attached to this species of Nomocharis, but in the circumstances confusion in nomenclature may be avoided by naming it as I have done *N. saluenense*, leaving to future investigation the settlement of relation to *L. apertum* var. *thibeticum*.

The species is a distinct one in the genus. One of Monbeig's plants under No. 68/1912 in the Edinburgh Herbarium, collected near Tseku, is a Nomocharis and a near ally of *N. saluenensis*, but the material is not sufficient for certain diagnosis.

Nomocharis tricolor, Balf. f.[2] (Sect. Ecristata.)

Glabrous plant as much as 35 cm. high. Bulb scaly ovate-oblong about 3 cm. long, scales fleshy ovate-lanceolate acuminate. Stem fleshy rooting above the bulb, about 2·5 mm. in diameter below the foliage-leaves. Foliage-leaves single at the nodes below, more or less paired or in whorls of three towards the top, lanceolate shortly acuminate 4–5 cm. long about 1·2 cm. broad more or less, dark green above, paler somewhat glaucous beneath, with three conspicuous nerves and some subsidiary parallel ones. Flower large solitary terminal erect or slightly nodding; pedicel stout about 3·5 cm. long. Perianth openly concave

[1] Notes R.B.G. Edin., vii (1912), 38.

[2] *Nomocharis tricolor*, Balf. f.—Bulbus squamatus. Caulis ad 1 m. vel ultra, supra bulbum radicans. Folia sparsa superne plus minusve 2–3-verticillata, lanceolata acuminata 4–5 cm. longa, ad 1·2 cm. lata, subtus pallida subglauca. Flores solitarii ad 8 cm. lati; pedicelli ad 3·5 cm. longi. Perianthium aperte concavum roseum luteo-oculatum basi rufescenti-maculatum et variculosum; segmenta subaequalia ovalia vel oblongo-ovalia acuminata apice excepta integra; calycina eglandulosa; petalina basi bifoveolata foveolae cujusque parvulae labio ecristato. Stamina ad 1·5 cm. longa; filamenta ovario sublongiora, infra inflata, in apicem brevem subulatum attenuata; antherae circ. medium dorsifixae.

as much as 8 cm. across, rose-coloured with a broad yellow eye, spotted and blotched at base dark purple-red; segments subequal outer a little longer about 4 cm. long almost 2 cm. broad oval or oblong-oval shortly acuminate, tip obscurely fringed otherwise margin quite entire; sepaline segments eglandular; petaline segments bifoveolate at base, foveola on each side of midrib small with a short convex not crested flap. Stamens 6 about 1·5 cm. long; filaments about 1·2 cm. long a little longer than ovary from a slightly flattened base upwards dark-coloured, swollen to nearly 1 mm. in diameter through about 9 mm., then tapered through about 3 mm. as a needle-like thread; anther about 6·5 mm. long dorsifixed about the middle. Ovary about 9 mm. long oblong slightly wider at top; style about same length as ovary, clavate.

S.E. Tibet. Ka-gwr-pw. Alpine meadow. 14,000 ft. F. Kingdon Ward. No. 801. 19.7.13.

A very distinct species. Easily recognised by the tricoloured flower.

Nomocharis Wardii, Balf. f.[1] (Sect. Oxypetala.)

Glabrous low herb some 12 cm. high. Roots thick fleshy. Bulb scaly slender oblong elongated as much as 3 cm. long 1 cm. in diam., outermost scale-leaves at flowering time mucilaginously rotting, within scales of the year straw-coloured few 5–6 open fleshy linear-lanceolate acuminate apex soon withering. Stem short about 3 cm. above ground thin with short internodes and bearing at most about 8 alternate ascending leaves. First leaves short more or less cataphyllary at and below soil surface, green foliage-leaves linear-ligulate as much as 9·5 cm. long 8 mm. broad with long attenuate hardly acute point, slightly paler below,

[1] *Nomocharis Wardii*, Balf. f.—Glabra humilis. Bulbus elongatus ad 3 cm. longus tenuis squamatus, squamis paucis (5–6), apertis carnosis anguste lanceolatis acuminatis apice mox marcescente. Caulis epigaeus brevis ad 3 cm. longus. Folia basalia 1–2 squamosa, superiora circ. 8 alterna lineari-ligulata ad 9·5 cm. longa 8 mm. lata subtus pallidiora. Flores solitarii ad 9 cm. lati; pedicelli ad 8 cm. longi apice cernui. Perianthium luteum emaculatum aperte concavum; segmenta fere consimilia anguste lanceolata longe acuminata margine sub apice obscure fimbriato integra; calycina eglandulosa; petalina glandula basali bipartita labio cristato instructa. Stamina ad 1·8 cm. longa; filamenta ovario longiora infra paullo inflata in apicem brevem subulatum attenuata; antherae infra medium dorsifixae.

with midrib and two lateral veins conspicuous and some subsidiary parallel nerves. Flower solitary terminal with a long stout brown glossy pedicel as much as 8 cm. long 1·5 mm. in diameter, straight erect to nodding swollen apex. Perianth openly concave about 9 cm. across yellow unspotted blotched at the base: segments similar in form narrowly ovate-lanceolate tapering to a long acuminate point which is obscurely fimbriate: calycine about 4 cm. long 1 cm. broad, basal blotch small, eglandular; petaline about 3·7 cm. long 1·2 cm. broad with a 2-lobed basal gland half on each side of prominent midrib, each lobe yellow-fringed the fringe or crest running upwards for a very short way along the midrib. Stamens 6 about 1·8 cm. long; filaments about 1·2 cm. long longer than ovary slightly flattened at very base, slightly swollen upwards to about 1 mm. from top then attenuate in a subulate tip; anther about 9 mm. long shortly apiculate dorsifixed about 3 mm. from base. Gynaeceum about 2 cm. long: ovary oblong pyriform 6-angled, angles rounded faintly 6-tubercled at summit; style about 1·2 cm. long clavate beneath the trumpet-shaped end with marginal 3-lobed stigma.

S.E. Tibet:—Doker La. Open grassland. Shrub and forest belt. Alt. 13,000–14,000 ft. F. Kingdon Ward. No. 741. July 1913.

S.E. Tibet:—Ka-gwr-pw. Alpine meadow turf. Alt. 15,000 ft. F. Kingdon Ward. No. 813. 19.7.13.

A beautiful species not yet in cultivation. Its nearest ally is the plant described by Franchet as *Fritillaria lophophora*,[1] afterwards renamed by him *Lilium lophophorum*.[2] Ward's plant can be recognised by its grass-like foliage and the many more leaves which each stem bears. I do not find on the petaline segments of *N. Wardii* any marginal fimbriation at the base such as characterises Franchet's species, and is perhaps more constant than Franchet supposed to be the case.

This *F. lophophora* of Franchet has particular interest in relation to the question of the limits of the genus Nomocharis which we have been considering. When he described

[1] Franchet in Journ. de Bot., v (1891), 153; Oliv. in Hook. Ic. Pl., xxiii (1894), t. 2219.

[2] Franchet in Journ. de Bot., xii (1898), 221.

the species Franchet recognised the likeness to Nomocharis in the form of bulb and the crested petaline glands. At that date *N. meleagrina*, with its almost similar perianth-segments, was unknown, and Franchet naturally laid stress upon the dimorphous perianth as a mark separating Nomocharis from his new species. Now we know the character fails in generic diagnosis, and the stamens subulate from the base in *F. lophophora* are alone left of the points of difference named by Franchet to distinguish it from Nomocharis. Here, now, in *Nomocharis Wardii* we have an approach to the abolition of this staminal distinction. The filaments are inflated, though not to the extent of those in the first described species of Nomocharis, and in consequence of this less inflation the subulate top of the filament appears as a gradual attenuation of the swollen portion—does not sit like an apiculus on its summit. Whilst treating *F. lophophora* as a Fritillaria, Franchet did not do so without qualification. He recognised those characters of the bulb and the petaline glands, to which I have drawn attention, as alien to Fritillaria, and he proposed to constitute under the name of Lophophora a new section of Fritillaria, to be characterised thus:—"Bulb squamate; perianth-segments not dissimilar, traversed at the claw by crested fimbriate lamellae; staminal filaments subulate; style undivided." These characters are found, as I have shown, also in *F. oxypetala*, *F. Stracheyi*, and I believe also in *F. flavida*. They are the essential characters of my section Oxypetala of Nomocharis. Franchet has preferred to use the characters for a distinct section of Fritillaria. I have preferred to widen the scope of Nomocharis and make a section in that genus—and because

(*a*) the bulb and the petaline glands are not fritillarioid but are nomocharoid;

(*b*) the obstacle of the nomocharoid staminal filaments is broken down by the almost transition in *N. Wardii* and the Ecristata section of Nomocharis.

There is a middle course—to make a new genus for these Lophophoras and Oxypetalas intermediate to Fritillaria and Nomocharis. That may come when we know more of this group of plants, which appears to have attained

to some considerable development in Western China—and be it noted alongside of a similar development of true Fritillaria with the globose bulb formed of rounded, somewhat separate scale-leaves, and with the campanulate perianth of segments all bearing a larger or smaller median nectary—*F. cirrhosa*, *F. decussata*, *F. Delavayi* are illustrations. We may count upon more of both groups being discovered, showing perhaps other modifications into which the type has passed. Meanwhile, as I had to name the plants collected by George Forrest and by Kingdon Ward, I have endeavoured to sift the relationship of forms as we know them.

In 1898 Franchet translated *Fritillaria lophophora* into *Lilium lophophorum*, because "it has so much in common with *Lilium oxypetalum*, Baker, and *L. apertum*, Franch., that it is impossible to place it in a different genus. The bulb, the form of perianth, the dorsifixed versatile anthers are more characters of Lilium than of Fritillaria—a genus which cannot be precisely defined at the present time unless one restricts it to species with a campanulate corolla of the type of that in *F. Meleagris*, and especially to those in which the style is trifid." I agree with Franchet, except that his argument leads me not to Lilium but to a new genus or to Nomocharis, qualifying this statement, however, by saying that I have not had opportunity of examining *Lilium apertum*, which I take to be a plant not unlike *L. oxypetalum*, Baker, seeing that Franchet had previously thought it was this species.

Clathrus cancellatus, Tourn.

Notes on the Occurrence of Clathrus cancellatus, Tournf., in Argyllshire. By Very Rev. David Paul, D.D., LL.D. (With Plate No. VI.)

(Read 13th December 1917.)

This fungus was found by me on 10th September 1917 near Kilmelford, Argyll, growing in a flower border extending along the wall of a shooting-lodge. There were about six specimens, mostly in the "egg" stage. One that had burst the skin of the "egg" developed well later, and was photographed. Other two were also brought home, and grew to maturity.

It appears that this fungus has not been found before in Scotland. In England it is rare, and confined to the extreme south. It has been found in the Isle of Wight, Torquay, Lyme Regis, Haslemere, Bournemouth, and near Windsor. It has never been gathered by the British Mycological Society in any of their forays. It is said to have been found in the south of Ireland.

Beyond Britain the plant occurs frequently in the south and west of France, but not apparently north of the latitude of Paris. It is found also in Italy and Southern Europe in general; also in the Mediterranean islands and in North Africa. It is said also to have occurred near Brussels and between Haarlem and Amsterdam. Krombholz does not appear to have found it in Bohemia.

Clathrus cancellatus is a fungus of the order *Phalloidei*, of which *Phallus impudicus* is among us the best-known representative. It is a very conspicuous and beautiful plant. At first it is enclosed in a volva, with a raised pentagonal network, and a long, white slender root. When the volva bursts, the hymenium inside expands, and rises in the form of a circular or ovoid hollow sphere to a height of about four inches. This sphere is perforated in lattice- or trellis-fashion (hence the specific name), and the exterior colouring is a fine pinkish-red. The interior of the anastomosing branches is covered with an olive-brown mucus in which the spores are embedded, as in *Phallus*. The odour is extremely disgusting, so that the plant cannot be brought into a room, but this odour disappears in drying.

How this fungus, which seems to require warmer conditions than are to be found in Britain, appeared in Argyll I cannot explain. Spores may have been brought north among the roots of some imported plant, but I did not notice any such growing in the neighbourhood. It appeared to me that the occurrence of this rare fungus in Scotland was worthy of being noted by the Botanical Society.

I may add that I found at Kilmelford this autumn a good many specimens of *Clavaria aurea*, Schaeff., and of *Clavaria botrytis*, P.—both rare in Britain.

A New Grass, Koeleria advena, Stapf.

By James Fraser.

For the name of a new grass belonging to the genus *Koeleria*, and for its description by Dr. Stapf, I am indebted to the Director of the Royal Botanic Gardens at Kew.

This grass I found in July 1916, in the neighbourhood of Edinburgh, growing among surroundings and under conditions which indicate that its seeds must have been introduced into this country along with esparto grass, from the east of Spain or the north-west of Africa.

Two or three specimens have been retained at the Kew herbarium.

Dr. Stapf's description is as follows:—

Koeleria advena, Stapf (sp. nov.).

Affinis *K. scabriusculae*, Hack., sed valvis obtusiusculis vel minute emarginatis (haud acuminatis biaristulatis) muticis vel sub apice mucronulatis valvam aequantibus (haud ea conspicue longioribus) distincta.

Gramen gracile annuum. Culmi fasciculati, erecti vel geniculato-ascendentes, graciles, 10–35 cm. alti, glabri vel internodiis inferioribus apicem versus minute puberulis, 2–5-nodi, nodo summo multo infra medium sito. Foliorum vaginae arctae, tenues tenuiter pubescentes vel summa subglabra, praeter infimas internodio breviores; ligulae breves, membranaceae, rotundatae; laminae patentes anguste lineares, superne attenuatae, acutae, 8–30 mm. longae, 1–1·5 mm. latae, molles, pubescentes, ad margines

scabriusculae vel basin versus etiam ciliatae. Panicula angusta, contracta, ambitu sublinearis, inferne interrupta vel lobata, 3–5 cm. longa, 6–10 mm. diam., ramis ramulis pedicellis glabris laevibus vel superne scabriusculis; pedicelli perbreves, rare 2 mm. longi. Spiculae ambitu obovatae, 4–5 cm. longae, superne 2–3 mm. latae, 3–4 florae, glabrae nitidulae. Glumae aequilongae, spiculam subaequantes a latere visa oblongae, obtusiusculae, 3-nerves, pallidae magis minusve purpureo-suffusae. Rachilla internodiis minute pilosulis circiter 1 mm. longis. Anthoecia 3 mm. longa, sursum per paulo minora, summum ad squamulas minutas reductum. Valva a latere visa anguste oblonga, obtusiuscula vel minute emarginata, saepe sub apice tenuiter mucronulata, in dorso tenuissime scaberula, tenuiter 3-nervis. Valvula valvam aequans, 2-dentata, hyalina, albo-nitens. Antherae 2 mm. longae.

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

VOLUME XXVII.

PART IV.

SESSION 1918-19.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY BY
NEILL & CO., LIMITED.

And to be obtained from the SECRETARY OF THE SOCIETY, *at the Royal Botanic Garden.*

1919.

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TRANSACTIONS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXIII.

Calamagrostis stricta and C. strigosa.

By A. Bennett, A.L.S.

(Read 2nd October 1918.)

C. stricta, Timm (sub *Arundo*), in Roth. n. Beit., i, 118 (1782). I use the above name and reference for the present as the name and author are not finally settled.

The first record of *stricta* was in Eng. Bot., t. 2160 (1810), from "a marsh called the White Mire a mile from Forfar, June 1807." It became extinct here about 1813 through the marsh being drained for its marl. In 1836 it was found by Dr. Moore in Ireland; in 1846 by the Rev. G. E. Smith at Delemere in Cheshire; in 1887 I recorded it from Yorkshire in the Naturalist, p. 201. In 1914 it was sent me from Hockham and Stow Bedon in Norfolk by Mr. Robinson. In Caithness it was found about 1866 by Robert Dick[1] of Thurso.

The following varieties are now on record for the British Isles.

1. var. *Hookeri*, Syme, Eng. Bot., ed. 3, xi, 56 (1872). Armagh, Tyrone, Derry, and Antrim, Ireland. Stow Bedon!, Norfolk.

2. var. *borealis* (Laest., sub *Arundo*). Killin, Mid. Perth. Mr. Druce, 1888!, and Mr. Burdon 1917!. Described by Laestadius in Bid. till Kann. Tornea Lappmark, p. 44 (1864).

[1] Smiles' Life of R. Dick, 340 (1878).

3. var. *angustata*, Wahlenb. (sub *Arundo*), Fl. Lapponica, 28 (1812). Margin of Loch Watten, Caithness, G. Lillie sp.

4. var. *pallida*, Ruprecht, Hist. Fl. Petrop., 35 (1845). Hockham, Norfolk. Mr. Robinson, 1914!.

Hooker, Brit. Fl., ed. 1, 32 (1830), gives another station, "Rescobie, four miles from Forfar. T. Drummond," and this is repeated by Hooker and Arnott in 1860, but I can find no specimens extant from there.

Ascherson and Graebner, Flora Mitteleup. 208 (1899), have a "var. *viridis* Torges," whether this is the same as Ruprecht's *pallida* I do not know: and they have a var. *interrupta*, but later than Wahlenberg's, and they do not refer to that. It seems that our plant may not be the same as the Central European one, or perhaps as some of the Scandinavians, but the whole genus in Europe requires revision, no two authors agreeing as to the species, varieties, or hybrids. It varies greatly in the length of the glumes and the relative length of the hairs and awns. In the specimens in which the glumes are so reduced in length (3 mm.): why is it the hairs are not proportionately reduced? But this is not the case in the Norfolk specimens, in some of which the hairs are nearly as long as the glumes ("half as long in the type"). In some of the Caithness specimens the glumes are unusually long, and these have been called var. *scotica* by Mr. Druce, but Timm, in Mag. fur Nat. und Oec., Meklenburg (1795), called this *C. neglecta β stricta*. This name *neglecta* was used by Erhart in his Calamarioe, Dec. 3, 113 (1786), and in his Beit., vi, 137 (1791), sub *Arundo*. Looking at specimens from all our recorded stations, I am inclined to think we have more than one species under it, but it requires careful collation and comparison with authentic specimens. As none of our Floras contain descriptions of the varieties, I here append them:—

2. *borealis* (as a species) Laest., in l.c.

"var. A. arista subdorsali, lana corollea brevior, caulis foliata. Panicula stricta patens, foliis radicalia dilatata, aspera, stricta, elongata," a. *paludosus*.

"*β arenivaga*, Laest., panicula stricta patens, radix longe latique repens, folia stricta dilatata, sub exsiccatione convoluta, filiforma."

3. var. *angustata*, Wahl., l.c.
"panicula elongata lineari, floribus linearibus."
4. var. *pallida*, Rupr., l.c.
panicula greenish-yellow, stiff and closed.

C. strigosa, Wahl. (sub *Arundo*), Flora Lapponica, 29 (1812), t. ii.[1]

In June and July 1885, Mr. J. Grant of Wick sent me a series of specimens from the drained site of Loch Duran. On examining them it seemed to me that some of them could not come under *C. stricta*, and were either *borealis* or *strigosa*, but having no specimens of either, I sent some to Mr. N. E. Brown of the Kew Herbarium. He replied (20.7.85), "The grass sent, after comparison and dissection, appears to be *C. strigosa*, Hartm., though the ligule is not so long or acute as in the typical plant, but I do not see what else it can be. *C. stricta*, with var. *borealis*, both have shorter glumes." In November 1885, Dr. Almquist of Stockholm wrote me, "*C. strigosa* very near the Norwegian form." In 1895, M. Husnot wrote to my late friend Mr. Beeby, "une examplaire Anglais il ne differe pas du *strigosa* recolté par Straberg en Norvege et je crois la plant anglais est bien *strigosa*." Then Dr. Druce sent specimens (but I cannot say they were the same as mine) to Dr. Hackel, our best authority on Grasses, and he named them "*C. stricta*," and said "*strigosa*" is considered a hybrid of *stricta* with *C. Epigeios*. The Swedish botanists do so consider it, but the Norwegian Blytt (ed. Dahl) Norges Flora, 77 (1906), places it as a species with *stricta*. Now the distribution of *stricta* and *Epigeios* is not altogether against this, except that *C. strigosa* is recorded from Nova Zembla and *Epigeios* is not. A few months ago I wrote to my friend Dr. Otto Nordstedt of Lund, enclosing some florets of the Caithness plant, asking him to compare them with Wahlenberg's types. These, he told me, are at Upsala and referred me to Dr. Zuel there. Dr. Zuel kindly sent me some florets from Wahlenberg's types from "Tana-elf in Finmark," in N. Lat. 70° 30′. In these I can see no sign of *Epigeios*, whose glumes are so stiff and different. Although called "elf" (*i.e.* river), it is situated about half-

[1] Trans. Edin. Bot. Soc., xvi, 313, 1886.

way down the Tanafjiord. It is curious that the label of Wahlenberg's specimens runs thus: "*Arundo hispida* Finmarkia via Tana-elf . . . 14 Juli 1802, Wahlenberg." "In herbario Wahlenbergi sub titulo *Av. strigosa* Fl. Lapp. teste M. A. Lindblad." Dr. Zuel writes: "It is curious that Wahlenberg has written '*hispida*' on the label. I suppose that he has called the plant so at first, and then has altered the name to *strigosa* when he published his description of it." Now in *stricta* the Floras all say the ligule is short, truncate, or split, and in twenty-eight specimens, Scotch and English (not Irish or Caithness), the ligule is 2 mm. long, and truncate. In the specimens I call *strigosa* the ligule is 4 mm. long, and acute or subacute.

Scandinavia is so rich in species (15) of this genus that it is rather remarkable that Scotland is so poor. I see that Sir J. E. Smith, under *stricta* in English Flora, i, ed. 2, 170 (1828), remarks, "Hairs but half the length of the largest valve, a little elongated as the seed ripens."

C. strigosa occurs in Finmark, Russian and Swedish Lapland, W. Bothnia, Iceland, Greenland, and Nova Zembla: *C. Epigeios* in Finnish Lapland (in 68° 45′ N. Lat.), "in regione pinifera";[1] in Russian Lapland, at Kitsa, in 69° N. Lat. *C. stricta* in Russian Lapland to 68° N. Lat., and to 68° 30′ N. in Finnish Lapland.[2]

In his description of *stricta* Wahlenberg says, "arista tenui sub apice inserta corollam subaequante"; in *strigosa*, "arista tenui dorsali corollam aequante." Comparing florets of the Delemere, Cheshire, plant, I find under a $\frac{1}{4}$-lens the awn equals in many florets the palae. It may, however, be said the period of growth may have something to do with this. In Norfolk specimens of *stricta* the awn is actually 2 mm. longer than the palae (gathered end of June). Does this not tend to show that our plants want more examination and comparison with European examples? And some of the hairs are also longer than the palae.

[1] Wainio, La flore Lapp. fin., 75 (1891).
[2] Herb. Mus. Fenn., 23 (1889).

Notes on the Flora of Caithness.

By A. Bennett, A.L.S.

(Read 2nd October 1918.)

In the Scottish Botanical Review (July 1912, 181) I noticed the species Mr. Crampton had noted as additional records in his Vegetation of Caithness considered in relation to the Geology, 1911, published by the Committee for the Survey and Study of British Vegetation; but did not allude further to it. It is, from the ecological point of view, a most excellent piece of work, and makes points not noticed before in British books, and must be well studied by the author of any future Flora of Caithness.

Along the east coast he gives some really extraordinary assemblages of plants, as at Leabana Daione opposite Ramscraigs, between Berriedale and Dunbeath in a landslip of the sandstone cliffs. He gives a list of ninety plants, with *Caltha palustris*, Linn., having leaves 6 inches across on stalks 18 inches long, *Angelica sylvestris* 6 ft. high, and *Pteris aquilina* head high and difficult to enter. There is a continuous dropping of water from above, where at Ramscraigs a height of 380 ft. is given by the O. Survey.

There are still about twenty-six species that may occur in the county, with records in counties and vice-counties ranging from 81 to 111, there being no climatal or distributional reason against their occurrence.

In the following notes I give such species that have been found or recorded since my last notes appeared.[1]

Ranunculus scoticus, Marshall.—Growing with *Saxifraga Hirculus*, Linn., at Loch Rhuard. W. G. Lillie sp.

There are some violas I meant to record here, but I have not received Dr. Drabble's names for them.

Saxifraga stellaris, Linn.—Morven. Crampton, p. 43. He remarks that this is the only place he has seen this *Saxifrage* in. Morven seems poor in alpines, while within

[1] Trans. and Proc. Bot. Soc. Edin., xxvii, 135, 1916–17.

twelve miles, on Bein Griam Mhor in Sutherland, there is found among others, *Saussurea alpina*, *Saxifraga oppositifolia*, *Silene acaulis*, *Lycopodium annotinum*, *Dryas octopetala*, and *Cornus suecica*. Mr. Crampton reports that prolonged search failed to find any of these on Morven, Maiden Pap, or any other hills or crags in the county.

Parnassia palustris, Linn., var. *condensata*, Wheldon and Travis.—Coast swamp. Dunnet Links. 3.8.1915. E. S. Marshall sp. Described from specimens gathered on the Lancashire coast and figured in the Journal of Botany, li, 87 (1913).

Scabiosa succisa, Linn.—A form of this species grows near Wick. A living plant was sent me by Mr. R. Bain of Wick. The root leaves are 13 cm. long (lamina, 9 cm.) × 6 cm. wide, much thinner in texture than usual, fringed with long (3 mm.) hairs, nearly glabrous above, sparingly hairy on the under surface. The usual size of the leaves is 13 cm. × 3 cm., but in Killin, Perth, plants they are 35 cm. × 5 cm.

Matricaria inodora, Linn., var. *phaeocephala*, Rupr.—East of Reay. Marshall, Jour. Bot., 1916, 169.

Andromeda polifolia, Linn.—Mentioned by Mr. Crampton as on record for Caithness, but I do not know where so recorded. In Scotland it occurs in the Inner Hebrides (V.C., 102), "Jura, 1812," Dr. Walker sp., on the west and to Perth on the east. Still it may occur, as it reaches Nordland in Sweden, appears in North and South Norway, and in Finnish Lapland to 68° 22′ N. Lat. Mr. Watson, Cyb. Brit., ii, 153 (1849), observes: "The distribution of this little shrub is peculiar in Britain, whether compared with that of other species which are assigned to the Scottish type, or with its distribution on the Continent of Europe. It differs from the usual character of the Scottish or boreal type by its early northern limit."

Bartsia Odontites, Huds., var. *litoralis*, Reich.—By roadside pond, four miles W. of Thurso. E. S. Marshall sp. By a pond at Lower Dounreay on the coast east of Reay. E. S. M. sp.

Euphrasia borealis, Town.—Roadside, four miles W. of Thurso. E. S. Marshall sp.

Euphrasia curta, Wett.—Coast rocks, just above high water, E. of Reay. E. S. Marshall sp.

Utricularia vulgaris, Linn.—Waterston Loch, E. coast. G. Lillie sp. A second locality for the county.

Rhinanthus borealis, Druce.—Near Thurso. J. Grant sp. Sea cliffs, Freswick. J. Grant sp.

Atriplex laciniata, Linn.—Mr. G. Lillie has sent me specimens of the above plant, larger than any southern specimens I have seen, from the coast. It was growing with *A. Babingtonii*, Woods, and *A. prostata*, Bouch.—the latter specimen agrees with others so named by the late Herr Freyn. The seed leaves of *laciniata* are larger than those of other species of the genus, and first leaves are in the north (E. Sutherland) semi-rotund and nearly entire. It occurs in the O. Hebrides!, W. Sutherland, and the Shetlands, but is not quite certain for the Orkneys, though Mr. Spence sent me a very young plant that is probably it. An additional record for the county.

Orchis ericetorum, Linton.—Stroma Isle. Miss Geldart sp.

Orchis Fuchsii, Druce.—Caithness. Report of Bot. Ex. Club for 1914 (1915).

Sparganium ?.—Halkirk. 8.1886. Dr. A. Davidson sp. Suggested by Dr. Rothert in 1911 to be a hybrid between *S. affine* and *S. minimum*.

Juncus supinus, var. *nigritellus*, Schultz t. Buchenau.—Near Wick. J. Grant sp.

× *Salix ludificans*, F. B. White (*S. aurita* × *phylicifolia*). —"Caithness. Grant ex Bennett." White.

Carex incurva, Lightf., var. *erecta*, Lange.—Among rocks just above high-water mark, east of Reay. E. S. Marshall sp.

Carex disticha, Huds.—Marshes east of Reay. E. S. Marshall sp.

C. extensa, Good., var. *pumila*, And.—Shore, east of Reay. E. S. Marshall.

C. Oederi, Retz.—Coast rocks, east of Reay. E. S. Marshall sp.

C. limosa, Linn.—Yarehouse Loch. Crampton.

C. curta, Good.—Fairly common in the wet flashes of the moorland. Crampton.

Arrhenatherum elatius, M. et K., var. *bulbosum*, Presl. —Near Reay. E. S. Marshall sp.

A. precatorium, Dietrich.—Lower Dounreay. Marshall, Jour. Bot., 169 (1916).

Catabrosa aquatica, Beauv., var.—Wet sand, Dunnet Bay. E. S. Marshall sp. "Annual prostrate, etc." I can find no record of an annual form of this species.

Chara hispida, Linn.—Pond, east of Reay. E. S. Marshall, Jour. of Bot., 169 (1916).

Notwithstanding Mr. Crampton had access to all parts of the county, being on the Geological Survey, he missed Mr. Lillie's records of *Saxifraga Hirculus*, Linn. and *Atriplex laciniata*, Linn.

The latter name is the one used in the last edition of the London Catalogue, but it certainly is a bad name as the leaves are never *laciniate*, but Dumortier's name *A. farinosa* (1827) is preoccupied by that of Forskill (1775), and Woods' name of *arenaria* by that of Nuttall (1818). Even with the account in the Cambridge Flora of the genus, I think our plants are by no means settled.

Potamogeton longifolius, Gay, in England.

By Arthur Bennett, A.L.S.

(Read 4th December 1918.)

Potamogeton longifolius, Gay, in Poir. Ency. Meth., supp. iv, 535 (1816).

P. lucens, Linn., b. *longifolius*, DC. Fl. Fr., v, 311 (1815).

P. macrophyllus, Wolfg., in R. et S. Syst. N. Mant., iii, 358 (1827).

P. lucens, Linn., b. *fluitans*, Coss. et Germ., Fl. Paris, 574 (1845).

P. lucens, subsp. *macrophyllus*, Wolfg., Nyman Consp. Fl. Europe, 682 (1882).

P. lucens, subsp. *longifolius*, Magnin, Bull. Soc. bot. Fr., 440 (1896).

P. lucens, subsp. *macrophyllus*, Hags., in Neuman's Sver. Fl., 797 (1901).

Ledebour, Fl. Russ., iv, 27 (1853).

Gren. et Godr., Fl. Fr., iii, 315 (1855).

Mühlein et Kupfer, Korresp. d. Nat. Ver. Riga, 46, 161 (1906).

Richter (Pl. Europe, i, 14, 1890) following Ledebour, *l.c.*, refers *P. salicifolius*, Wolfg., *l.c.*, and *P. lanceolatus*, Eichw., Nat. Skizze Lith., 126, 1830, to *longifolius*, but I think this is not correct.

The first description is that of De Candolle, who remarks: "M. Guersent a trouvé cette variété dans la rivière de Bapaume; elle est remarquable pour la longueur extraordinaire de ses feuilles, elles ont jusqu'à un pied de longueur sur 8–9 lignes de largeur, et se terminent en pointe allongée pas les deux extrémités." That of M. Gay is: "P. foliis oblongo-lanceolatis, utrinque acutis, subsessilis, pedunculis, longitudine foliosus: spica longa, tereti." Distribution: France!, Lithuania!, Baltic provinces of Russia, Asia, Sherard. herbarium at Oxford!, Africa! Those so named from Sweden by Dr. Tiselius are rather a long-leaved form of *lucens*. The same occurs in Orkney (Johnston!). The Swiss record is also an error, teste Dr. Schröter. The specimens so named from Siberia (Herb. petrop.) are the same as Tiselius', and would come under his name of *f. insigne*. The Grand Junction Canal at Market Harboro', Leicestershire, Mr. Geo. Chester, 1916.

The leaves in the British specimens are 2–3 dm. long × 2 cm. wide (the Lithuanian specimens vary from 1·50–3·20 dm. × 2 cm.). Leaves darker in colour than *lucens*, and almost throughout their length parallel-sided. The colour is darkest in Wolfgang's specimens, lightest in Besser's, while those of Gorski come between. In the Vienna herbarium Wolfgang has a specimen "*P. macrophyllus* mihi Tab. 16." This refers to a MS. Monograph of the genus in the Library of the Moscow Soc. Imp. Naturalists. He also with Besser published many dried specimens of the genus. In *P. longifolius* we have a plant that has gradually descended from a species to a sub-var. in Das Pflanzenreich (1907) by Graebner, but in 1913 the same author makes it a variety, quoting Cham. et Schlecht. in Linn., ii, 198 (1827), but they merely say "*f. longifolia*." Dr. Hagström (in litt.) places much reliance on the serra-

tion or non-serration of the leaves in the *lucens* group; but in *decipiens*, Nolte (by this method made into two hybrids by Graebner, *l.c.*), the serration is not constant, due in some cases to age: in others the early leaves are not so, later ones are so, as I have proved by testing dozens of specimens under the microscope. With these specimens Mr. Chester sent others that seem to me to be a hybrid with *perfoliatus*, Linn.

With regard to Wolfgang's description of the leaves, "margine crispatis," this is not shown on his specimens, but perhaps is only apparent when living. Then the stipules, "stipulis magnis, elongatis, obtusicaulis," in the majority of specimens this holds good, but in one of Besser's the upper ones are decidedly acute. In the Vienna herbarium there is a specimen from "Oregon, U.S.A., Lyall, 1861, Boundary Commission." This in 1892 I referred to Gay's plant, but now I would not be sure; it may not be the elongated form of *lucens* but perhaps the *f. insigne*, Tiselius. The *P. longifolius*, Gay of Babington, Eng. Botany, supp. t. 2847 (1840), is not the plant of Gay, but I believe a hybrid. I have named it in Jour. Bot., xxxii, 204 (1894), *P. Babingtonii* = *P. lucens* × *praelongus*. It is usually stated that only one specimen was gathered in Lough Corrib in 1835 by Mr. J. Ball; this is not so. Two were gathered, one sent in the fresh state to Professor Babington, and one retained by Mr. Ball. Its history may be summarised as under: Babington in 1840 considered it Gay's plant; Hooker and Arnott in 1860 was undecided where to refer it; Syme in Eng. Botany thought at first it might be *praelongus*; Hooker's Students' Flora, ed. 3 (1884), rather contradicts itself; Fryer in 1890 placed it under *decipiens*, Nolte, but does not notice it in Potamogetons of the British Isles; and the Messrs. Groves in the 9th edition of Babington's Manual retain the account of the 8th edition and add Fryer's and Bennett's opinions.

Notes on Dr. Hagström's "Critical Researches on Potamogeton, 1916." By Arthur Bennett, A.L.S.

(Read 4th December 1918.)

Dr. Hagström's material was mainly restricted to the Scandinavian herbaria, with a few from St. Petersburg and Berlin; hence the distribution of the extra-European species is very meagre. To obviate this I sent him full particulars of all the species he has treated of, relating to their distribution. Still, it shows their herbaria are rich in the genus. It is to be regretted he could not consult our herbaria, nor those in Paris, Munich, and Vienna, nor Boissier's and De Candolle's, though he had my papers on those herbaria. In this work the author has contributed a large amount of original work. He relies greatly on anatomical characters—too much, it seems, when one tries to verify his facts by the aid of specimens grown for years. My late friend, Mr. Fryer, for many years tested the plants by growing them in tubs and in a pond in his garden, and his work shows that too much reliance cannot be placed on Dr. Hagström's conclusions; in fact, as in all systematic botany, all and every aid is needed that can be brought to bear before we can safely say, "This is that, and that is this."

The following notes are a running commentary on his work, taking it in the sequence he adopts.

Potamogeton filiformis, Pers.—As to Fries' note on Boccone's fig., Ic. descrip. Sic. et Mel. Gall. It., t. 20, f. 5, 1674, named "*pusillum fluitans*," if it is not a fair one of Wolfgang's *P. fasciculatus*, what is it? Not *pusillus*, for certain. He quotes under *filiformis*, *P. maritimum*, Pohl; but Pohl places this as a synonym under his *pectinatus*, adding *P. marinus*, L., with a reference to Eng. Bot., t. 323, and Fl. Danica, t. 186, both of which are *pectinatus*, Linn.; so I do not see how it can be placed as a synonym of *filiformis*, as it is by the author, I quite agree with the author in making *filiformis* a full species, equal to *pectinatus*.

P. vaginatus, Turcz. (Europe, Asia, America).—I cannot help thinking there is some error as to this species. The

author has not seen an original specimen, but he notes that Kihlman had (Medd. Soc. Fl. et Fauna Fennica, xiv, 111, 1888). I possess two from the St. Petersburg herbarium, from the author. They bear little resemblance to the Swedish specimens named by Kihlman, but I hope to send them to Dr. Hagström.

P. pectinatus, Linn.—I quite agree with the author in referring *P. columbinus*, Suksdorf (Deut. Bot. Monatss., xix, 92, 1901) to this, which Mr. H. St. John also does in Rhodora, 124, 1916. It may here be noted that the author uses "turios" for the winter-buds or gemmæ, but he also applies this name to the resting-buds on the roots; but the structure of these is quite different, though they admittedly answer the same end. He divides *pectinatus* into five varieties and twenty-one forms, placing *P. striatus*, Ruiz et Pavon, under three of them. The var. *mongolicus*, Ar. Benn., he thinks may prove a new species, but I do not consider the material is sufficient to so decide. He places *P. latifolius* (Robbins), Morong, under *P. zosteraceus*, Fries, but Robbins, in Bot. 40th Par., 338 (1871), distinctly disclaims this, and it is a distinct species and very rare. The "New Jersey" station given by Graebner, Das Pflanz., Heft 31, 128, 1907, is an error. The only other stations known, besides the two given by Morong, are "Huachina Mts., Arizona, 1882, G. Lemmon and wife," "King's River, Lasson Co., California, Watson," Bot. Calif., ii, 1880, and Mono Co., 1898, No. 9915, J. W. Congdon.

P. Robbinsii, Oakes (America).—One of the most distinct species in the genus, and with *P. Maackianus*, Ar. Benn., unique in structure.

P. Maackianus, Ar. Benn. (Asiatic).—The author remarks on Dr. Graebner's (*l.c.*) putting this species near *obtusifolius*, and says it is an error; but I can explain this. Dr. Graebner drew *Maackianus* and named it *ochreatus*, Raoul (a near ally of *obtusifolius*). Fortunately I saw this in the proof and corrected it, but Dr. Graebner neglected to revise the reference, although I pointed out to him that there was this error.

P. ochreatus, Raoul (Australia and New Zealand).—Dr. Hagström makes a "new species (vel subspecies *P. ochreati?*) *P. furcata*, Hagst." I can well understand his

position here; for *ochreatus* he had access to New Zealand and Tasmanian specimens only. Most of these are unbranched. They are much "stretched," *i.e.* the internodes are long, as much as 18 cm. long, with very few branches if any (1–2), while in N.S. Wales specimens they are only 3–6 cm. long, and branched at every node with stout branches (*i.e.* furcate). Then he says of his new species the leaves are "cuspidata"; so they are in Victorian specimens. Like all the narrow-leaved Potamogetons, this goes through a series of changes in leaf-apices from early growth to flowering state. In Raoul's specimens (lower portions especially) the leaf-apex is, as he describes it, "linearibus apice rotundatus vel truncatus," while in N.S. Wales specimens (Yarrogobilly River) the leaves of the flowering portion are subacute! I have specimens from "Australia felix," Baron v. Mueller (which he gives as one of the two stations of his new species), but it is *ochreatus* without any doubt. Again, he gives "stylus elongatus subcurvatus." This is simply a question of age in the style, not the resulting condition of ripe fruit. He admits the "Anatomia, vide supra," i.e. *ochreatus*. Again, the plant varies greatly in colour, from the green of New Zealand and Tasmanian specimens to the brownish green ("fusco-viridia") of the Murray River and other specimens. A far wider divergence from Raoul's specimens is shown by one from the Murray River (Tepper leg.). This has internodes only 2 cm. long, branched at every node, leaves 6–8 cm. long by 6 mm. wide (Raoul's has them 2–3 mm. wide), stipules stronger than usual, 20 mm. long, semi-translucent, and quite a brownish green. This I have called *f. latifolia*. The habit and aspect of the plant is so different that, taking the single specimen, it might well be another species, but in all essential characters it is *ochreatus*, Raoul. Dr. Hagström had four specimens at his disposal for his two species. I had twenty-four at mine. I see in Raoul's second description (Choix pl. Nou. Zélande, 13, 1846), he says, "Stylus v. stigma minimum, introrsum, obliquum." That disposes of the new species.

P. Ulei, Schum. (Brazils).—I do not grasp either Schuman's reference in Fl. Brazil., iii, 3, 690, 1894, or Hagström's. The first refers to *P. ochreatus*, Raoul. The nervation in this

is totally different to *Ulei*. The latter says, "The leaves taper more abruptly into an apex" (*i.e.* than in *P. polygonus*, C. et S.), but this is certainly not so, neither in a specimen from Brazil nor in the drawing in Graebner's Das Pflanzenreich, fig. 25, 105 (1907). I quite think, however, with Hagström that Graebner's drawing of the fruit is much more like *polygonus*; for this see Cham. and Schlecht. Linnaea, ii, t. 4, f. 11 (1827).

P. confervoides, Reich. (United States).—This remarkable species was named in the Vienna herbarium by Schweintz "*P. monticola*" (*i.e.* a dweller in mountains), and he remarks, "Sub hoc nomine missa desiderata species in Auctoribus Amer. sept. Purshuis, Torreiyo, Darlingtoni, Nuttalli." So the author adopts this as a division, *i.e.* "Monticoli."

P. subsibericus, Hagst. (North Asia).—The author kindly sent me a portion of this, and he is quite correct in considering it distinct from *P. sibericus*, Ar. Benn., only once gathered by the Russian Geographical Expedition.

P. foliosus, Rafin. (N. America).—He remarks, "I scarcely understand how to establish a real difference between the two Morongian varieties *niagarensis* and *californicus*." Yet Tuckerman made the first into a species, and lately Piper (Cont. U.S. N. Herb., xi, 637, 1906) made the second into a species, but later he wrote (April 1915) "that after all he thinks Morong may be right." The difference between the very narrow-leaved form and *californicus* is great, but is one of size and degree only. Is it possible that the Sandwich Islands station, "I. of Oahu, in Lower Pauca, A. A. Heller, No. 2387, 2555, 1895," Brit. Mus., and "I. of Ranai along the Hawpape River, A. A. Heller, 1895," is the result of the "driftwood thrown on the shores from N.W. America," mentioned by Wallace, Island Life, ed. 2, 320, 1892?

P. turonifer, Hagst. (*P. foliosus* × *pusillus*).—The specimens certainly seem to decide this is the hybrid, as the spikes are quite infertile where they occur.

P. strictifolius, Ar. Benn. (United States).—The author suggests this may be *P. foliosus* × *panormitanus*. His plant may be so—I have not seen it,—but the Canadian fruiting plant is certainly not so. The specimens of the

U.S.A. plant are not from "E. Chicago Lake, Ind.," but from Wolf Lake, Hammond, Ind. Then again he suggests his hybrid plant shall bear my name of *strictifolius*, and the Canadian plant be renamed. Why? I protest against such a course; there is no reason for it. Let Dr. Hagström name his hybrid as he likes, but my plant must bear the name I have given it.

P. gemmiparus, Robbins (United States).—Referred by the author to *P. rutilus*, Wolf. × *Vaseyii*, Robb. I much wonder what American botanists will say to this combination.

P. panormitanus, Biv.—Here the author shows by an excellent piece of writing that this must be held a separate species from *pusillus*, notwithstanding the opinion of Italian botanists that it is only a synonym of *pusillus*. The following are additional localities to those given by Dr. Hagström: Méry-sur-Seine (Aube), France, Hariot; Valais, Switzerland, Herb. Thomas; Louisiana, Durand, No. 672, U.S.A.; San Luis Potosi, Mexico, J. G. Schaffner.

P. antaicus, Hagst. (Canary Islands).—The author need not doubt this being a new species and quite separate from *P. denticulatus*, Link! Link's species is nearest to *P. trichoides*, C. et S., and *P. condylocarpus*, Tausch.

P. Berteroanus, Phill., and *P. Aschersoni*, Ar. Benn. (S. America).—No doubt these have been confused, even by Phillipi himself; but the *pusillus* section in South America needs careful working out. The specimens are mostly very poor, and without soaking out are simply puzzles.

P. orientalis, Hagst. (Asiatic).—He here solves a problem that no one attempted, though for some years I had this laid aside as a nov. sp. with drawings. Whether the Chinese and Corean specimens can be placed here is to me yet doubtful, as contrasted with the Japanese.

P. obtusifolius, M. et K.—Authors have accepted the reference of Lessing's *P. tartaricus* to this species without demur. But the author's description seems to me to place it outside, one item alone, "multinervis," being decisive, and he notes it cannot come under "Merton and Koch's species *zosterifolius* or *compressus*, L. (here evidently referring to *P. Friesii*, Rupr.) or *pusillus*, L." I am

inclined to think, from a study of his description, that it may be my *P. Henningii* (Jour. Bot., xlviii, 151, 1910): but I have been unable to find a specimen of his plant in any herbarium.

P. loculosus, Hagst. (Himalayas).—I agree with the author in referring Dr. Brandis' "No. 3333, 1864," from the Himalayas to a new species. My specimen has a few leaves only, and *obtusifolius* seemed the nearest, as he allows.

P. lacunatus, Hagst. (British N. America).—I have specimens from Salt Lake, Anticuli, Quebec, J. Macoun, which he gives as one of the stations for his nov. sp., and the references show it is the same; but there must be some error, as my specimens have five-veined leaves, and the lacunae in the centre are only a little more than is usual in *P. Friesii*. Are different plants distributed? If not, why cannot it be named young *Friesii*?

P. javanicus, Haskl. (Asia, Africa, Australia).—Here I quite agree with the author in making this into four species. In fact, has he gone far enough, as he himself suggests at page 133? There are differences in Japanese, Indian, and African specimens that eventually may prove specific.

P. lateralis, Morong.—He refers this to *P. pusillus* × *Vaseyii*, Robbins, and I see no reason why such may not be upheld, though some time ago I suggested another combination.

P. quinquenervis, Hagst. (Australia).—Only one station is given for this, hence two more may be quoted. "Upper Copmanhurst, J. L. Boorman, 1909, New South Wales. A fairly common Potamogeton in the Upper Clarence in fairly shallow water." Moreton Bay, Queensland, Bailey, 1882.

P. Vaseyii, Robb. (United States).—"Spike bearing on submerged part. Greenwood Lake, N.Y., 1892, T. Morong, U.S.A." In the specimens from "Hemlock Lake, N.Y., U.S.A., 1882, Hill," Morong has mixed *Vaseyii* and *lateralis*, Morong. In three specimens I have from Dr. Robbins there is no sign of spikes from the lower branches.

P. dimorphus, Raf., *P. Spirillus*, Tuck. (North America).—Gay, in Compt. Rend. Acad., xxxviii, 702 (1854), made a

genus of this *Spirillus*, and he has in his herbarium at Kew "*S. diversifolius*, Gay. Int., July 1850."

P. diversifolius, Rafin., var. *spicatus*, Engelmann in Geyer's "Plants of Illinois and Mississippi," Am. Jour. Science, 46 (1843). This answers the author's query as to where described.

P. pennsylvanicus, C. et S., *P. Nuttallii*, C. et S. (N. America) teste Morong. — The name I suggested ex. Rafinesque "*P. epihydrum*" must be dropped, as the author points out, as the submerged leaves are certainly not "subcordatus."

P. alpinus, Balb. — I am much disappointed that Dr. Hagström has not done for this what he has for *nitens* and *decipiens*. Not only has no one collated the various varieties, etc., but Dr. Fischer has made it more difficult by giving some of the older names a different value to what the authors did.

P. Tepperi, Ar. Benn. (Philippine Islands).—The Australian is the true plant. I had mixed others with it, not Asiatic!

P. insulanus, Hagst. (W. Indies, Porto Rico).—I agree in referring the Porto Rico specimens to a new species, and they are certainly the same as Graebner names "*P. Nuttallii*, var. *portoricensis*."

P. hindostanicus, Hagst. (India).—Schlagintweit's No. 4615 from the Western Himalayas, I thought might be *P. malaianus*, Miq., but my specimen is a miserable scrap, and the Bengal one not much better, so the author may be right here.

P. fibrosus, Hagst.—I cannot think this species can be upheld. To make a new species from one specimen, and that without a collector's name or whence it came, with only "91" on the scrap of paper, is surely unsafe. Dr. Hagström supposes it may originate from S. Africa. If this were carried out in herbaria, ours would supply several, but I never thought of suggesting them as new species.

P. membranaceus, Hagst. (Australia).—Simply a state of my *P. australiensis*; I am not surprised. I have the same gathering as the author describes his plant from. Some were *P. Cheesmanii*, Ar. Benn., others *australiensis*. It was years before I got together a series to show this, and mainly by the aid of Mr. Maiden of Sydney.

P. montanus, Presl (Mexico, Peru).—" = *P. mexicanus*, Ar. Benn." This can hardly be. Why should Presl in Herb. Prague! name it *P. peruviana* if he had named it *montanus* before?

P. muricatus, Hagst.—The Walcha (N.S. Wales) plant is too near *sulcatus*, Ar. Benn., but others no doubt belong to it from Victoria (Australia), and specimens in the British Museum herbarium from "Mauritius, 1819, Sir James M'Grigor," evidently belong to it. This last sheet is the only one I have seen in any herbarium from Mauritius. I made a drawing of this, and the author's drawing might well have been a copy of mine. The specimens, three in number, are named "*P. lucens* with floating leaves." In my MS. notes on these I have written, "If this is not *P. sulcatus*, Ar. Benn., or *P. tricarinatus*, Muell. et Benn., then it will be a new species." It is a remarkable distribution, from the Mauritius to Australia, "but some of the reptiles and insects have Australian affinities, . . . hence we find comparatively few cases in which groups of Madagascar plants have their only allies in such distant regions as America and Australia" (Wallace, Isl. Life, ed. 2, 442, 1892). Another interesting fact is that the leaves of these specimens are of what may be termed the leathery texture of the floating leaves of the Australian species. Wallace (*l.c.*) further remarks: "There is no portion of the globe that contains within itself so many and such varied features of interest connected with geographical distribution as Madagascar and the smaller islands which surround it."

P. reduncus, Hagst. (W. Australia).—The author says that I named a specimen of this *P. Drummondii*, Benth. How this came about I cannot now tell, but Herr Baagöe must have made some mistake or shifted labels. The only specimens of *Drummondii* I ever had were half the whole collection sent me by the late Baron von Mueller, and these were the only ones in Europe (except the ones at Kew from which Bentham described the species). And the plant is abundantly distinct from any other, having ulva-like submerged leaves, as noted in the Fl. Aust., vii, 171 (1878).

P. nodosus, Lamarck = *P. Americanus*, C. et. S. — A

detailed and excellent account is given of this species, though he includes under it many names of which he has not seen specimens. These are nearly all in the Berlin herbarium, whence I had them many years ago, and made drawings of them for reference.

P. fragillinus, Hagst.—I am puzzled how the author connects my *P. lucens*, var. *floridanus*, with the Guatemala plant which he names as above. I know that Dr. Morong named this *fragillinus* as *P. malaianus*, Miq. The author refers to Graebner, Das Pflanzenreich, Heft 31, 79 and 161 (1907), where no mention is made of the Guatemala plant when *floridanus* is described.

P. variifolius, Thore (France).—The author refers this to *P. natans* × *P. trichoides*. Until this is produced by cultivation I must say I cannot believe it.

× *P. Champlanii*, Ar. Benn. (United States).—In answer to the author's remarks, I say that this has submerged leaves entire! They are 11 cm. long × 10 mm. wide, 7-nerved. The upper (floating) leaves are 6–8 cm. long × 11–15 mm. wide, obtuse.

P. capensis, Scheele = "*P. Schweinfurthii*, Ar. Benn."—But Scheele's name is only in the Bremen herbarium, and only noted by me, so cannot stand. If this were allowed, there are dozens in the Vienna and Berlin herbariums that might be used.

P. gramineus, L. (*P. heterophyllus*, Schreb.).—Dr. Hagström gives no conspectus of the varieties, only a running commentary on them. The difficulty is great, I know, and perhaps he is wise, not having seen the series in other herbaria.

P. nitens, Weber.—The fullest and best study of this species yet given.

P. Oakesianus, Robbins (United States).—"The specimens from Pine Plains, N.Y., leg. Hoysradt (hb. Stockholm), must be considered the hybrid *gramineus* × *natans*." Whatever the Stockholm specimens are, mine from the same place (*with good fruit*) are certainly *P. Oakesianus*, Robbins. Some error in labelling?

P. lucens, L.—Dr. Hagström suggests that the African and other forms placed under this species need careful revision, and I agree.

P. Chamissoi, Ar. Benn. (Mauritius, Rodrigues).—Under *P. crispus*, L., the author remarks, "*P. Chamissoi*, Ar. Benn., must be ranked under the Lucentes." I do not know what induced this remark, but I suppose Graebner's placing it next *crispus*, as I distinctly state it has nothing to do with *crispus* (Jour. Botany, xlii, 74, 1904). Yet the strange thing is that the earliest specimens from Mauritius, "Roxburgh. 1819." are named "*crispum*," and the latest, "H. H. Johnston. 1889." are also named "*crispus*." And I believe this is the plant named *crispus* in Baker's Fl. Mauritius, 392 (1877), and also the plant sent by Bory de St. Vincent to Chamisso (before 1814), but to which he put no name in Linnaea, ii (1827), 200, which he puts under *lucens* (from the "L'ile de France"). Thus there must be something that suggests *crispus* to those who have gathered but not studied the plant. The author has only seen Johnston's specimens. On present knowledge this well-marked species is confined to the three Mascarene islands. It might perhaps have been expected in Madagascar, as they have another "*Lucentes*" species between them, *i.e. P. vaginans*, Bojer, of which there is a type-specimen in the Vienna herbarium. To me it stands apart, just as *P. Robbinsii*, Oakes, does in North America.

P. lithuanicus, Gorski (Lithuania).—The author remarks, "I have also examined specimens from Lithuania labelled '*P. salicifolius*' which have been identical (identified?) with another hybrid, *P. lithuanicus*, Gorski, but they cannot be regarded as authentic." So he places *salicifolius* under *nitens β subperfoliatus* (Hagst.), *f. praelongifolius*, Tis., and *lithuanicus* he puts under *decipiens β brevifolius*, Hagst. I have a specimen of *P. lithuanicus*, Gorski, from the author himself, and it is labelled "*P. lithuanicus*, S. B. Gorski proff., 1847, E. flumine Vilia, Lithuania." It is absolutely identical with Wolfgang's *salicifolius*. In fact, it is more like Wolfgang's own specimen I have, than those in De Candolle's herbarium from Besser. In neither case do I consider them the hybrids he places them under.

P. Gaudichaudii, C. et S.—The author notes that Graebner, in Das Pflanzenreich, Heft 31, 79 (1907), remarks, "Specimena originalia desunt." This is certainly so regarding Chamisso's, but there is an original one in the herbarium

Delessart at Geneva labelled "*P. lucens*, Isles Mariannes, Gaudichaud." These islands, formerly called the Ladrone or Thieves' Islands, were also named by Magellan (1521) "Islands of Triangular Sails." The plant has been collected by an American botanist, "M'Gregor, No. 424, in 1913," in the original locality, "River Aganà, Guam." These are at Manilla, Philippine Islands, and specimens were sent me by Mr Merrill.

P. decipiens, Weber.—The author disposes of Graebner's division of this into two. The fact is, the denticulation of the leaves in this is greatly a matter of age. Some leaves are denticulate; others on the same specimen are so minutely so as hardly to show under a $\frac{1}{4}$-inch lens. The arrangement of this by measure may be useful, but it is certainly in many cases misleading. In May leaves will be under one variety, in July and August under another. Mr Fryer insisted that these plants must be studied in the spring state, and I agree. No sectional anatomy can alter facts noted when the plants were grown and gathered month by month.

P. biformis, Hagst. (Asiatic, Mongolia, Japan).—This will stand as a species, as *P. distinctus*, Ar. Benn. (Mongolia, Japan), has entire leaves and no sessile ones like those figured by the author.

P. perfoliatus, L., var. *Richardsonii*, Ar. Benn. (N. America).—This has been made into a species by Rydberg in Bull. Torrey Bot. Club, xxxii, 599 (1905). If you take the widest difference from typical *perfoliatus* (*i.e.* species with leaves $4\frac{1}{2}$ inches long), no doubt it looks a very fair species; but you must ignore all the others that come between that and the eastern U.S.A. specimens, many like var. *rotundifolius*, Wallr. Dr. Hagström seems inclined to accept this as a species, while acknowledging the anatomical differences are slight. When one comes to compare specimens from all over its distributional area (based on forty-three specimens in my herbarium), it breaks down as a species. Between the extreme western U.S.A. specimens and those from the Great Lakes there is much difference in aspect, and many Japanese specimens are half way between, and others approach the American *Richardsonii*. A remark by an excellent botanist in the

United States, the Rev. E. J. Hill, in the Bot. Gazette, 260 (1881), may here be quoted under *P. perfoliatus*: "Nearly all the plants gathered in the West have the lanceolate leaf, usually shorter than in the type specimen (var. *lanceolatus*, Robbins). They gradually vary with all degrees of difference between the variety and the typical species, so that it is often hard to tell to which they should be assigned." This is in the field, not herbarium study. It was this great difference that made me hesitate to make the variety *mandshuriensis*, Ar. Benn., a species. Dr. Hagström seems to think it may be so, and I believe the winged fruit is not the result of drying; hence it may be considered a species.

P. buplearoides, Fernald (United States).—This seems very near *perfoliatus* according to Dr. Hagström, but I have not seen specimens, and the only real difference seems the smaller fruit.

I should here like to mention a note by an ornithologist. Mr. C. B. Ticehurst, in Trans. Norf. and Nor. Nat. Soc., 195 (1918): "The affinities of most, if not all, animals are to be sought in the earlier stages of development rather than in the adult": and again at p. 200: "The greatest advancement in ornithology in modern times is, I consider, the recognition of *subspecies*, or racial forms." These two remarks are exactly what my late friend Fryer always pleaded for in Potamogetons. Lastly, how rich the Scandinavian herbaria are in this genus, collectors' names, etc., appearing that ours do not possess. Why? And unqualified thanks must be given to Dr. Hagström for the excellent use he has made of them, as a result of twenty-five years' study.

We are not yet in a position to dogmatise on many points of the genus. The naming of individual examples from small areas, without collating with those already named, is a mistake. They are valuable if accepted as results of local conditions, environment, climate, etc., but they are simply steps in evolution.

Notes from Cannock Chase on Vaccinium intermedium, Ruthe. By Captain W. Balfour Gourlay, M.C., R.A.M.C.

(Read 9th October 1919.)

Vaccinium intermedium is a natural hybrid between the Bilberry, Blaeberry, or Whortleberry (*V. Myrtillus*, Linn.), and the Cowberry (*V. Vitis-Idaea*, Linn.). Previously reported as occurring in a few places in Germany[1] —Ruthe's original specimens being gathered in 1826,—it was first recognised in Great Britain in August 1886 by Professor T. G. Bonney, who found it growing on Cannock Chase, in the centre of Staffordshire, in company with Bilberry and Cowberry. The plant was described by Mr. N. E. Brown, and illustrated in the Journal of the Linnean Society, xxiv, 125, pl. iii, the paper being read on May 5, 1887.

As early as 1870[2] an unusual form of *Vaccinium* had been discovered by D. Ball, Esq., F.R.C.S., in Maer Woods, near Whitmore (N.W. Staffordshire). Specimens of the plant were minutely examined by Mr. Ball and sent, with a description, to Mr. Robert Garner. Fruiting specimens were gathered in 1871. Mr. Garner, who firmly believed the plant to be a hybrid, showed these specimens to the Linnean Society on March 7, 1872, to illustrate a paper[3] "On a Hybrid *Vaccinium* between the Bilberry (*V. Myrtillus*) and the Cowberry (*V. Vitis-Idaea*)." This paper, however, failed to convince the Society as to the hybrid nature of the plants, "the general opinion elicited by their examination being that they were a luxuriant state of *V. Vitis-Idaea*, due to situation, rather than a hybrid." However, after Mr. Brown had read his paper in 1887, he received a letter from Mr. Garner concerning the specimens from Maer Woods. These Mr. Brown

[1] *Vaccinium intermedium*, Ruthe, Flora der Mark Brandenburg und der Niederlausitz, 377, pl. 1.

[2] Hardwicke's Science Gossip (1872), 248, "A Curious British Plant," by R. Garner.

[3] Journ. of Bot. (1872), 122.

examined and identified[1] as undoubted examples of *Vaccinium intermedium*.

V. intermedium has since been reported from the following localities:—

Scorriclett Braes, near Watten, Caithness.[2]
Gorge of Achorn Burn, near Dunbeath, Caithness.[3]
Coniston Old Man, Lake District, Lancashire.[4]
Lonsdale, N.E. Yorkshire.[5]

Military duties, which kept me stationed on Cannock Chase during the greater part of the year 1919, have thus given me good opportunities for observing the hybrid *Vaccinium* and noting points of interest.

Cannock Chase, the ancient hunting-ground of Norman and Mercian kings, is an upland region from 300 to nearly 800 feet above sea-level, situated in the centre of Staffordshire. It consists of immense deposits of pebble and sand resting upon beds of red sandstone and conglomerate, the whole covered over by a layer of peat of variable depth. Approaching the Chase from the north, we ascend through woods of oak and birch with an undergrowth of *Pteris aquilina* and *Scilla nutans*. Ericaceous plants gradually appear as the trees become scarcer, until the open moorland is eventually reached where *Calluna*, *Erica*, *Vaccinium* and, in places, *Empetrum* are seen to be the dominant species. Locally, in certain areas, *V. Vitis-Idaea* is present in great abundance, mixed with *V. Myrtillus*. It is in such areas that *Vaccinium intermedium* occurs. The preponderance of *V. Vitis-Idaea*, usually noted, might suggest the probability of its being the male parent of the hybrid.

The hybrid, as seen on Cannock Chase, presents several interesting features. In the upper part of the Sherbrook Valley and neighbouring plateaux it is locally very abundant, occurring in patches which are often widely

[1] Postscript to article "*Vaccinium intermedium*, Ruthe, a new British Plant," by N. E. Brown, Journ. Linn. Soc., xxiv, 125.
[2] A. Bennett, Annals of Scottish Natural History (1904), 249.
[3] C. B. Crampton, The Vegetation of Caithness considered in Relation to the Geology, 1911.
[4] Bot. Soc. and Exchange Club of Brit. Isles Report for 1915, 273.
[5] Ibid. for 1917, 116.

separated. Plants of *Vaccinium intermedium*, with the vegetative vigour common in hybrids, increase peripherally at the expense of the neighbouring flora, by pushing out creeping root-stocks in all directions. Thus the size of a patch of the plant bears a simple relation to its age. The various patches show considerable differences in habit, size, and shape of leaves and stem, flowering season and fertility, etc., though the plants in any one patch show a considerable degree of uniformity. This individuality, shown by the various patches, would tend to suggest that each patch owes its origin to a separate act of cross-fertilisation.

As there are many upland areas in Great Britain and Ireland where Bilberry and Cowberry grow together, it is curious that, while the hybrid is found in very few of such areas, it should be quite common in portions of one of them—to wit, Cannock Chase. As upland areas are peculiarly attractive to botanists, it can hardly be supposed that the hybrid is really comparatively common but usually overlooked. Some factor specially favouring the production or spread of the hybrid must then be present on Cannock Chase.

I first noticed the hybrid in May 1919, and showed it to Captain G. M. Vevers, R.A.M.C. (since demobilised). In the next few days we each found several other hybrid patches and compared them. Vevers pointed out that, of the seven hybrid patches then noted, six were growing in positions where some artificial and gross disturbance of the ground had occurred. Thus, in three cases, patches were found growing along the edges of trenches, the other three being found respectively: (*a*) on what looked like an old gun position, (*b*) on an area formerly used for bombing practice, and (*c*) on a pond embankment composed of layers of cut peat. The remaining site showed no obvious evidence of disturbance. The embankment appeared to be a work of much earlier date than the evidences of military training, and the hybrid patch upon it was much larger than the others. Vevers suggested that the violent crushing or shaking together of flowering plants of Bilberry and Cowberry might have resulted in their cross-fertilisation.

I have subsequently found many more patches of the

hybrid, and these have tended to confirm Vevers's observation. Thus, one afternoon and evening in August I collected specimens from thirty separate patches, noting any peculiarities of site in each case. The patches were situated as follows:—

On artificial banks of cut peat	9	
Along old cart tracks	7	
Along edges of drains cut on moorland or roadside	4	
On edges of trenches	1	24
About bomb holes	1	
On old gun position	1	
On moorland path	1	
Where no obvious evidence of disturbance was noted	6	

Total 30

Of the six latter sites, two were near mining villages where the common is well patronised, the other four being near camps, on ground long used for purposes of military training. On one roadside bank, built of peats, birches of considerable size were growing, and the hybrid had spread out from this bank over the neighbouring moorland to the extent of about a quarter of an acre. (The exact area, however, was difficult to determine owing to recent obliterating action of a moorland fire which had left here and there isolated portions only of the hybrid patch. These scattered portions may not, as at first supposed, have all been parts of the one large patch.) On a natural bank, near a hut constructed during the war, I found a single hybrid plant of two or three years' growth. An artificial bank often harbours several patches of the hybrid, while near it Bilberry and Cowberry grow intermingled, but with the hybrid absent. The places in Great Britain and Ireland where Bilberry and Cowberry grow together are usually wild and comparatively unfrequented. Though wild, Cannock Chase is much frequented.

Several groups of fruit-gathering children, on interrogation, pointed out "Bilberry" and "Bunchberry" (local name for *V. Vitis-Idaea*), but failed to distinguish the hybrid from Bilberry.

Though *Vaccinium intermedium* is thus apt to be mistaken for *V. Myrtillus* rather than for *V. Vitis-Idaea*, it resembles the latter in its evergreen leaves and almost cylindrical stem. The leaves, however, are usually less

glossy and more pointed than those of *V. Vitis-Idaea*, and, on the other hand, tougher and more deeply veined than those of *V. Myrtillus*, from which plant the hybrid can be distinguished by its subterete stem and less upright habit.

The hybrid flower is roughly intermediate in shape and colour between those of *V. Myrtillus* and *V. Vitis-Idaea*, but the anthers are provided with conspicuous dorsal awns, thus favouring *V. Myrtillus*. (The anthers of *V. Vitis-Idaea* are described in most of the text-books as "awnless." In most of the specimens that I examined in Staffordshire, small and inconspicuous dorsal awns were present. Some, however, appeared to be awnless.)

The hybrid fruit is a little smaller than that of *V. Myrtillus* or *V. Vitis-Idaea*. It is plum-violet in colour, and slightly longer than broad, but more regular in outline than that of *V. Myrtillus*. The latter often appears as if truncated about the calyx scar.

The hybrid produces little fruit, and the berries contain only a small proportion of well-developed seeds, though in this respect different patches show great variation. I have found large patches without sign of flower or fruit: and from a comparatively small patch (measuring 3 by 7 yards) I have picked over 200 ripe berries without exhausting the supply. One hundred of these berries, however, only yielded 209 apparently well-developed seeds, against more than 300 seeds for 100 berries collected from a variety of patches.

Professor Bonney found *Vaccinium intermedium* in full flower on Cannock Chase on August 29, 1886, but found only two ripe berries. I found the plant in full flower at the end of May 1919, and in full fruit in the middle of August. However, in the latter half of the month many of the patches were again in flower or in bud, including the one found flowering in May. Thus the hybrid, like *V. Myrtillus*, is wont to produce two crops (of flowers at any rate) during the season.

On August 23, 1919, I spent the greater part of the day in the Whitmore district of N.W. Staffordshire. Maer Heath and Whitmore Common are separated by a valley through which runs the main line of the L. & N.W. Railway. With the same Bunter grouping of pebble beds and sand-

stone. these uplands resemble Cannock Chase both geologically and botanically, but Maer Heath is largely planted with Scots pine. Mr. Garner, in his Science Gossip paper, tells us that this plantation is the one referred to by Darwin (Origin of Species, chap. iii), where he describes the changes in fauna and flora which had resulted from the enclosing a portion of the Heath with the introduction into the enclosed area of but one species (*Pinus sylvestris*), when a considerable increase in the number of species of insects and insectivorous birds was noted. I found four widely separated patches of the hybrid *Vaccinium* on Maer Heath, and one patch, with unusually fragrant blossoms. on Whitmore Common. The Maer Heath patches showed marked individuality of growth and habit. A small patch, growing on a dry artificial bank, showed a very striking reduction in the size of the leaves. Another patch, with large glossy leaves, though measuring only 9 yards by 16, was the largest that I found. (I was expecting to find a patch of considerable size.) Situated, however, in a dense part of the pine wood, its growth may have been retarded by shade. Growing near the edge of the wood and not far from houses, it might have been expected to attract attention. Moreover, twigs from this patch bear a marked resemblance to the figure illustrating Mr. Garner's article in Science Gossip for 1872. It is, I think, very probable that Mr. Ball collected specimens from this patch in 1870.

Some of these early specimens were sent to Charles Darwin by Mr. Garner, who referred to the plant as a hybrid. Darwin, taking also into account the shrivelled appearance of the pollen which Mr. Ball had noted, suggested that the seeds would show infertility. However, should the seeds collected this year on Cannock Chase prove to be fertile, it must be taken into consideration that the hybrid flowers may have been fertilised by the pollen of Cowberry or Bilberry.

The small hybrid patch (previously mentioned as measuring 3 by 7 yards, and giving a comparatively large yield of fruit) was a mere remnant round which a moorland fire had swept—a small green island in a sea of blackened ashes. The patch itself was an almost pure growth of the

hybrid, containing but a trace of Cowberry at one spot. Nine yards away a few small plants of Bilberry had survived. The fire took place before the plants could have set seed. The small percentage of good seed yielded by the berries from this patch (209 seeds from 100 berries, as compared with over 300 seeds from 100 berries collected [1] at random) may have been due to the comparative absence of pollen from Cowberry or Bilberry.

Seeds from this patch will be sown apart from the others, and any difference in the offspring noted.

If the hybrid seeds reproduce hybrid plants, one might expect occasionally to find hybrid patches growing apart from Cowberry and Bilberry. Out of some fifty hybrid patches examined, I have only seen *two* showing isolation from the parent forms—one being the patch isolated by fire, the other being the small-leaved patch on Maer Heath, where the dryness of an artificial bank had killed out all other vegetation and had notably modified the habit of the hybrid.

It is possible that birds do not carry the hybrid seed to any great extent. I have several times noted wounds on the ripe hybrid fruit, suggesting that birds, having tasted, had gone away to seek the more appetising Bilberry. Compared with Bilberry and Cowberry, the hybrid fruit is lacking in flavour.

If the hybrid seed reproduces parental forms, it will be of interest to note the proportion of Bilberry and Cowberry among the seedlings.

[1] Had the fruit collected "at random" contained no berries from the patch in question, the difference would have been even more striking.

N.B. The berries were gently broken under water, and the seeds extracted by a rough centrifugal method, so that only comparatively heavy seeds were counted.

Scottish Records of Myelophilus (Hylurgus) minor (Hartig). By R. Stewart MacDougall, M.A., D.Sc.

(Read 6th February 1919.)

This species has been described by Fowler as "very rare in Britain." In 1915 and earlier Mr. J. M. Murray found the workings of *M. minor* on Scots Pine in Murthly Woods. In 1915 Mr. James Munro found an imago in Forfarshire. In 1915 and following years Mr. Walter Ritchie found the beetle in all stages in very large numbers over an area of fifteen square miles in the Aboyne district of Aberdeenshire.

Lieut. R. Grant Broadwood, whose specimens I have verified, found the workings of *M. minor* as follows:—In Dungarthill Woods, near Dunkeld, on Scots Pine (the trees were dead), in July 1918. On the bark of blown Scots Pine (the trees were dead) on Muir of Thorn, Perthshire, in August 1918. On the bark of felled Scots Pine on Birnam Hill, Perthshire, in August 1918. On the bark of felled Scots Pine in woods round Pitlochry Hydropathic Hotel, in September 1918.

Mr. H. M. Steven writes as follows:—"During the past year I have found *Myelophilus minor* in two widely separated and different localities. The first record was obtained at Braigh Udine, Glengarry, Inverness-shire (6-inch Ordnance Survey, Sheet XCVI, Inverness-shire), in July 1918. This wood is an outpost of an old natural Scots Pine forest which stretched over this district. The trees are from 100 to 300 years old. *M. piniperda* was also present, but *M. minor* was the predominating species. The wood now forms an island in a sea of peat. About two miles away there is a planted wood containing Scots Pine, but careful search gave no trace of *M. minor* there. It would therefore seem probable that *M. minor* had bred for centuries in this old natural forest. The second record was obtained at Minkie Moss, Dupplin, Perthshire (6-inch O.S., Sheet XCVIII, Perthshire), in October 1918. *M. minor* predominated here also, and was busy at work on the dying and wind-blown Scots Pine."

The Preservation of Artificial Cultures of Moulds.

By Harry F. Tagg, F.L.S.

(Read 10th April 1919.)

A culture of a mould on nutrient gelatine or agar-agar may be killed with formaline vapour, and if it then be sealed up in the Petri dish in which it grew it will keep indefinitely, provided sufficient formaline vapour is present to prevent chance infection from the outside during the sealing process. The method ceases to be satisfactory when the mould is one that causes liquefaction of the medium on which it grows, because when this is the case the Petri dish cannot be tilted from the horizontal position. With cultures that are to be exhibited in a museum it is a distinct gain to be able to display them tilted at any desired angle, and with class specimens also it is an advantage to be able to handle them freely.

In the case of species that do not liquefy the medium, the latter may be cut out of the dish with the culture attached and dried down on a square of glass or stiff card. Cultures thus dried make useful reference specimens. The method has been advocated as a simple way of preparing herbarium specimens of artificial cultures grown on agar-agar.[1] It has the disadvantage where museum specimens are concerned and appearance is of importance that the surfaces of cultures tend to crack into discontiguous areas as the jelly matrix shrinks.

In the preparations now exhibited the difficulties associated with liquefaction of the medium and the areolation resulting from the contraction of the medium in the case of cultures that are dried, are alike avoided by the removal of the medium altogether. This has been done by floating the cultures on the surface of a dish of water warmed up sufficiently to cause the medium to melt. This method has given excellent results with cultures grown on gelatine, but is not so well suited to the preservation of agar cultures because of the slow solubility of the latter medium. In carrying out the method the procedure is as follows:—

[1] Hedgcock and Spaulding, Journal of Mycology, xii (1906), p. 147.

After cutting the jelly free of the edge of the Petri dish, the jelly is raised up slightly on one side by slipping under it the end of a broad section-lifter, and at the same time this side of the dish is slowly submerged in warm water. The jelly with the culture on it floats up from the bottom of the dish and the gradual total submersion of the latter leaves the culture free on the surface of the water. Any liquefied medium present diffuses at once, and the rest of the medium sinks and diffuses as it slowly melts. A square of glass of suitable size, or a piece of card if the specimen is to be preserved dry on a card, is passed below the culture and the latter is lifted carefully from the water. A certain amount of water will be taken up on the support, and this serves to permit the culture to be floated to any desired position. Absorbent paper applied to the edge of the support takes up this excess water, and the culture settles down in contact with the support and adheres to it.

If a dry preparation is wanted, all that it is necessary to do now is to allow the preparation to dry slowly in the air.

Reference collections made in this way, if mounted on glass supports of uniform size, may be stored in grooved boxes of the kind used for the storage of photographic negatives.

If the preparation is to be much handled, the surface of the culture should be protected. I adopt in this connection one or other of the following devices:—

A watch-glass sufficiently large to cover the culture is inverted over it, and is fixed in position by a thin layer of Canada balsam smeared around the edge. When this first luting has set firm the preparation is sealed up with a final luting of gold size, asphalt, or white cement. Alternatively, the culture may be protected by a plane glass disk supported on a circular wall of shellac or wax spun by means of a turntable around the outside of the culture. A cell of suitable depth is made and the glass disk luted down with gold size, the procedure being quite the same as that usually followed in mounting a microscopic object in a cell under a cover-glass.

Cultures so prepared make very good reference specimens,

but in the case of cultures intended for museum exhibition I prefer to adopt a method that secures a moist atmosphere over the cultures while at the same time the subaerial mycelium is preserved in a thin layer of glycerine which gives to the hyphal filaments a translucence that approaches closely the appearance they have in the living culture. In following out this modified method the procedure is the same as that already described, up to the point when the culture is adjusted on the support and is brought in contact with it by the withdrawal of the excess water. The support is then carefully dried round about the culture. A preserving fluid made of equal parts of formaline, glycerine, and water is placed in small drops around the edge of the culture just outside the limit of its growth. This fluid runs under the culture and penetrates the subaerial hyphæ, but does not wet the surface or alter appreciably the appearance of the aerial parts. An inverted watch-glass or a glass disk is now luted down with gold size in the manner already described for dry preparations, but it is necessary to remember when covering such preparations that the inside of the cover-glass should be coated with a thin film of glycerine so that any condensation of moisture on the under side of the cover-glass may not obscure the culture beneath it. It should also be borne in mind that luting cements, as a rule, are rendered less adhesive if the glass they are applied to bears even a very thin film of glycerine, and precautions should be taken to prevent the preserving fluid spreading from the culture to those parts of the supports to which the sealing cement will be applied.

As supports for cultures, squares of glass, for most purposes, are better than cards. They permit the back of the culture to be examined, and with a glass support one is able to use either transmitted or reflected light when examining the culture under the microscope.

Whytockia, a new Genus of Gesneraceae. By W. W. Smith, M.A. (With Pl. VII.)

(Read 13th February 1919.)

Whytockia, W. W. Sm. Genus novum Gesneracearum.

Genus *Staurantherae*, Benth. valde affine. Ab illo genere imprimis corollae ecalcaratae structura, stylo longo gracili, ovario subbiloculari recedit. Forma structuraque floris *Didymocarpum* et *Chiritam* suggerunt.

Herba parum ramosa. Folia ampla, membranacea, opposita, altero nano stipuliformi. Flores satis magni, rosei, laxe racemoso-cymosi. Calyx late campanulatus membranaceus, 5-fidus, sinubus haud plicatis, segmentis subaequalibus. Corolla tubuloso-ventricosa, tubo haud calcarato; limbus 2-labiatus, labio postico bifido, antico 3-fido. Stamina perfecta 4, inclusa, basi corollae inserta; antherae cohaerentes, loculis divergentibus confluentibus. Discus angustus annularis. Ovarium liberum, ut videtur biloculare; stylus satis longus, gracilis, stigmate bilobato; placentae undique ovuliferae. Capsula depresso-globosa vix exserta, membranacea, in speciminibus nostris irregulariter rumpenda sed fortasse obscure bivalvatim dehiscens. Semina permulta oblonga.

Whytockia chiritaeflora (Oliver), W. W. Sm. Nom. nov.

Staurantherа chiritaeflora, Oliver in Hook. Ic., Tab. 2454.

West China:—Province of Yunnan, at Mengtsz, in a dark damp glen under shady precipices; rare. Hancock. No. 51 in Herb. Kew.

var. **minor,** W. W. Sm.

A typo flore multo minore divergit.

West China:—Yunnan, at Feng Chen Len, in mountain forests. Alt. 7000 ft. Flowers pink; 2 ft. high. Henry. No. 11,232 in Herb. Kew et Herb. Edin.

A full description of the typical plant is given by Oliver in Hooker's Icones under plate 2454. Oliver preferred to retain the plant under *Staurantherа*. Recent collections

Whytockia chiritaefolia (Oliver), W. W. Sm., var. *minor*, W.W. Sm.
Type in Herb. Edin.

Photo. R. M. Adam.

W. W. Smith.

from China tend to show that Southern and Western China is rich in *Gesneraceae*, and many of the novelties cannot be referred to the known genera of India, Burma, and Malaya. The generic name is in honour of Mr. James Whytock, President of the Botanical Society of Edinburgh, a distinguished sylviculturist and horticulturist.

OBITUARY NOTICES.

William Watson, M.D., Deputy Surgeon-General, I.M.S.

Dr. William Watson, President of the Edinburgh Botanical Society for the Sessions 1897–1899, died after a long illness on 16th June 1912, aged eighty years.

He was the son of William Watson, Esq., Sheriff-Substitute of Aberdeenshire from 1829 to 1866, who was one of the pioneers in connection with ragged schools and is still remembered in Aberdeen for his philanthropic work.

Dr. Watson distinguished himself during his medical studies at the University of his native city and took his degree when barely twenty-one years of age. After a course of study in Paris, he joined in 1853 the East India Company's service as assistant surgeon, and was attached to different European regiments which were stationed at Meerut, Agra, etc. In 1856 he was offered and accepted the post of civil surgeon at Mynpoorie, in the North-West Provinces.

When the Mutiny broke out in 1857 it found Dr. Watson still on duty there. The whole surrounding country in a short time was seething with rebellion, and reluctantly it was decided that all Europeans should leave Mynpoorie for Agra, where they could take refuge in the fort. The magistrate knew that, in the event of those upholding the British authority leaving, there might be a massacre of all the loyal inhabitants, determined to hold to his post, and asked for volunteers to join him. Dr. Watson at once decided to remain with the magistrate, and alone, or almost alone, they stayed at this isolated station maintaining British authority without the necessary means of support.

Their brave action seemed to so impress the mutineers that they were some time in making up their minds to close in upon them, but at last the magistrate received private information that the Residency would be attacked upon a certain date and instructions had been given that they were all to be killed. He sent secretly a message to Agra about seventy miles away, and asked if relief could be sent them.

A small party volunteered to ride out to Mynpoorie, and arrived just in time, as the mutineers were upon the point of attacking the station. The magistrate determined to leave immediately in the darkness of night, and by morning, along with his small escort, was a long way on the road to Agra—the whole party thus escaping imminent death.

A short time after this Dr. Watson was encamped with his regiment on the ridge outside the walls of Delhi, and when the final attack was made and the gates of the city were blown in, he, along with a subaltern officer of his regiment named Ewart, was early inside its walls—the houses along each side of the streets being still full of mutineers. The palace of the Mogul Emperors having been captured, Dr. Watson and his young friend Ewart, who afterwards rose to be the head of the police in the North-West Provinces, found difficulty in getting sleeping accommodation, and for six weeks they were obliged to sleep upon the floor of the beautiful pearl mosque within the palace walls. At the end of this time they got permission to leave the palace and take possession of a house that belonged to one of the native grandees who had fled, and during the remainder of their stay in Delhi at this time Dr. Watson and Ewart lived in those luxurious quarters.

Shortly after we find Dr. Watson at Agra, and during an engagement which resulted disastrously for the British, he got his skull fractured through being struck by a fragment of an exploded shell. While in this wounded state, and in the crowd of natives being driven back, he observed something lying among the feet of the routed men. A native who knew him was passing, and, pointing to the object lying on the ground, repeated the name of an officer whom Dr. Watson knew by name. Although in a dazed

state he at once rushed to the rescue, and, as no one would stop a moment to help, he managed to get the wounded man upon his back and carried him for about half a mile until he reached a waggon, when he collapsed himself. Watson and the officer he had rescued were both taken to the hospital within the fort at Agra, and at first it was thought that Dr. Watson's wound was much more serious than that of the other man; but the officer died, and Watson survived to live a life of much usefulness.

Dr. Watson married in 1867, and, accompanied by his wife, went out to India, and from 1867 to 1883 resided principally at Almora and Naini Tal. At Almora, the capital of the province of Kumaon, Dr. Watson had medical charge of the leper hospital for about ten years. He had great opportunities, and gained great experience in connection with the treatment of this disease.

He was a man possessed of the greatest possible amount of bravery, and, while very retiring and modest in his disposition, he would at times narrate to intimate friends some of his experiences.

While stationed at Almora, the Medical Department of the Government of India gave instructions that the lepers were to be treated with gurjun oil, and that it was to be administered in doses to be taken internally, and also that the diseased portions of the lepers' bodies were to be anointed with this new supposed specific. Dr. Watson, with a deep sense of duty, endeavoured to carry out the instructions of the Government Department; but he soon found out that, while there was no great difficulty in getting the native medical assistants to administer the oil for internal purposes, the patients themselves were not quite so amenable, as the taste of the oil was objectionable and its effects were upsetting. The native assistants also declined point-blank to anoint the wounds of the lepers, and in many cases Dr. Watson had to do it himself at the great risk of inoculation. This treatment was carried on for about eighteen months, and, as the results were very far from satisfactory and the inconvenience to the patients very great, Dr. Watson reported so to the Department. All he got in reply was a letter expressing dissatisfaction that his efforts had obtained such a poor result, and re-

marking that he might have done better. No doubt, whoever wrote this epistle was little aware of the self-sacrifice of Dr. Watson, and how he risked his life in trying to carry out the instructions of his medical superiors. But however unpleasant such a communication may have been at the time, Dr. Watson used in later years to consider it a great joke and an evidence of the want of appreciation on the part of some uninformed official at headquarters.

Such censure as this, however, did not prevent his promotion, and he became Deputy Surgeon-General a considerable time before his retiral from the Service.

For further information refer to the Transactions of the Edinburgh Field Naturalists' and Microscopical Society, vol. vi, pt. v (1912): In Memoriam, William Watson, M.D., I.M.S., by Mr. John Lindsay, pp. 447–452.

Symington Grieve.

Robert Chapman Davie.

Indirectly the war has robbed the Botanical Society of a member of its Council and a frequent contributor to its meetings in the person of Dr. R. C. Davie, Captain and Senior Chemist in the 4th Water Tank Company, R.A.M.C. The effects of an illness earlier in life precluded him from joining a combatant branch of service in the Great War, so he entered the Army in 1917 in a capacity in which his scientific education would find its full value. He served in France during the great push of 1918; but in January 1919 returned home on leave. He caught influenza on 27th January. Pneumonia followed, with rapid and fatal issue on 4th February. Thus terminates, at the age of 32, a life that was full of promise for the future; for in the short years given him Davie had already achieved much.

He was educated at the Glasgow High School, and passing on to the University of Glasgow, he graduated M.A. in 1907 with First Class Honours in English. His work in the Department of English Literature was such as would have justified his adopting some career in relation to it. But he had already taken the class of Elementary

Botany in 1905, as well as those in some other sciences; and a natural aptitude and taste for practical science held him. He took the B.Sc. degree in 1909, distinguishing himself particularly in Botany and Chemistry. But he decided upon the former as his life's work, and was promoted at once Junior Assistant in Botany in the University of Glasgow. Incidentally he had won the Dobbie-Smith Gold Medal, and held the Donaldson Research Scholarship.

While carrying out his departmental work with a cheerfulness and vigour that gave savour to its success, he entered at once on research. His first memoir was devoted to *Peranema* and *Diacalpe*, two genera of Eastern Ferns, which his observations have placed securely in their natural affinity. In 1912 he joined the staff of Professor Balfour in Edinburgh as assistant, and soon obtained promotion to the position of Lecturer, having special charge of the large classes for Teachers in Training. Meanwhile he was able to devote considerable time to research. He entered on a wide comparative investigation of the anatomy of the Pinna-Trace in Ferns, and he contributed two memoirs on this subject to the Transactions of the Royal Society of Edinburgh. His inquiry covered a large area of observation and was extended to the Cycads and Angiosperms. His results indicate that while in some degree the structure shown is related to immediate physiological needs, there is a substantial correspondence of detail with phyletic comparisons based on other characters. In fact, while the pinna-trace can be used as a subsidiary line of evidence, it cannot serve as a criterion of decisive importance in comparison. This was the most substantial contribution which he made to Botanical inquiry, and, together with his earlier papers, it provided his thesis for the Doctorate of Science in Glasgow, to which degree he was admitted in 1915.

Davie's investigations were, however, interrupted in 1914 by a journey to Brazil to collect materials for a comparison of certain Families of Flowering Plants. A grant was obtained from the Royal Society for this purpose. He travelled and collected in the neighbourhood of Rio and in the Organ Mountains. On his return, in the early days of the war, he first worked out his collections systemati-

cally; and he was already beginning the detailed comparisons when the insistent duty of military service came upon him. He qualified himself specially for the Water Service, and quickly rose to the rank of Captain in this responsible and necessary service. He was present in France with his unit during the retreat of the earlier months of 1918, and the subsequent advance. After the armistice he was granted leave in January 1919, and died while at home.

Davie had already made his mark as a teacher, an investigator, and an organiser in Botany. An easy diction, with unusual command of his native tongue, gave him a good footing as a Lecturer. It is an open fact that he ran a strong candidature for a Chair in one of the larger Dominions in 1917, and early promotion to Professorial rank was anticipated for him. A quickness of apprehension of facts and comparisons, good powers of observation, a lively imagination, and a very retentive memory gave him a hold as an investigator, which a judgment ripening with age would have strengthened and directed into useful channels. As an organiser his departmental work was marked by cheerful efficiency. His stimulating influence was shown in the part he took in founding the Glasgow University Botanical Society. In a wider sphere his activity as one of the Secretaries of the Botanical Section of the British Association had already brought him in relation with the great body of British botanists. At the age of 32 he had fully qualified for years of active usefulness. It is this which makes his early death all the more lamentable. Time and opportunity were against him. So that at the moment of his death he was *of* the Front rather than actually *at* the Front, both in Science and in War.

F. O. BOWER.

WILLIAM BRACK BOYD.

A past-president of the Society passed away on 16th March 1918 in the person of W. B. Boyd of Faldonside. He was born on 23rd February 1831 at Cherrytrees, Yetholm, and educated at The Grange, Sunderland.

He tenanted Hetton Hall, Northumberland, from 1859 to 1869, when he leased Ormiston in Roxburghshire; in 1881 he removed to Faldonside, which his wife had then inherited from an uncle. Living the quiet life of a country gentleman engaged in agricultural pursuits, he devoted much of his leisure to botanical studies and soon became known for his wide knowledge and successful cultivation of plants.

Elected a Fellow in 1871, he was President of our Society 1882–84, when he gave a Presidential address[1] on the Cultivation of Alpine and other Plants suited for the Rockery, and a Valedictory address[2] on the Study of Mosses.

Other societies also recognised his eminence as a botanist. He had twice been President of the Berwickshire Naturalists' Club, was President of the Scottish Alpine Club from 1891 till his death, and was also a Vice-President of the British Pteridological Society.

He is commemorated by having had two plants named in his honour, *Salix Boydii*, Linton, and *Sagina Boydii*, F. B. White.

A fuller account of this enthusiastic botanist will be found in the History of the Berwickshire Naturalists' Club, vol. xxiii, pt. iii, p. 423.

[1] Trans. Bot. Soc. Edin., xvi, p. 66. [2] Ibid., p. 181.

ROLL

OF

THE BOTANICAL SOCIETY OF EDINBURGH.

Corrected to October 1919.

Patron:

HIS MOST GRACIOUS MAJESTY THE KING.

HONORARY FELLOWS.

BRITISH SUBJECTS (LIMITED TO SIX).

Date of Election.

Nov. 1896. BAKER, J. G., F.R.S., F.L.S., 3 *Cumberland Road, Kew.*
Nov. 1888. DYER, Sir WILLIAM TURNER THISELTON, M.A., LL.D., K.C.M.G., C.I.E., F.R.S., *The Ferns, Witcombe, Gloucestershire.*
Dec. 1907. FARMER, J. BRETLAND, M.A., F.R.S., *Professor of Botany, Imperial College of Science and Technology, S. Kensington.*
Feb. 1911. MARSHALL, Rev. E. S., *West Monkton Rectory, Taunton.*
Feb. 1912. SCOTT, Dr. D. H., M.A., LL.D., Ph.D., F.R.S., *Oakley, Hants.*

FOREIGN (LIMITED TO TWENTY-FIVE).

June 1902. BONNIER, GASTON, *Professor of Botany, Paris.*
June 1902. BRITTON, NATHANIEL LORD, *Director of the Botanic Garden, New York.*
Feb. 1911. FLAHAULT, Dr. CHARLES, *Professor of Botany to the Faculty of Science, and Director of the Institute of the University, Montpellier.*
Mar. 1895. SARGENT, CHARLES S., *Professor of Arboriculture, and Director of the Arnold Arboretum, Harvard;—Corresponding Member, March* 1878.
June 1902. TIMIRJAZEW, Dr. K. A., *Professor of Botany, Moscow.*
June 1902. TRELEASE, Dr. WILLIAM, *University of Illinois, Urbana, Illinois, U.S.A.*
Mar. 1895. VRIES, Dr. H. DE, *Professor of Botany in the University, Amsterdam.*
June 1902. WALDHEIM, Dr. ALEXANDER FISCHER VON, *Professor of Botany and Director of the Imperial Botanic Garden, Petrograd.*
Dec. 1885. WARMING, Dr. EUGENE, For.M.L.S., *Emeritus Professor, Copenhagen.*

RESIDENT AND NON-RESIDENT FELLOWS.

No distinguishing mark is placed before the name of Resident Fellows who contribute annually and receive Publications.

* *Indicates Resident Fellows who have compounded for Annual Contribution and receive Publications.*

† *Indicates Non-Resident Fellows who have compounded for Publications.*

‡ *Indicates Non-Resident Fellows who do not receive Publications.*

Date of Election.

Dec. 1915. Adam, Robert Moyes, 17 *W. Brighton Crescent, Portobello.*

Feb. 1905. †Aiken, Rev. J. J. Marshall Lang, B.D., *The Manse, Ayton, Berwickshire.*

Nov. 1884. †Alexander, J. A., *Houghton, Rossmore Avenue, Parkstone, Dorset.*

Nov. 1914. Alexander, J. H., 8 *Chamberlain Road, Edinburgh.*

Mar. 1915. Alexander, Miss A. S. M., B.Sc., *High School, Stirling.*

Dec. 1913. Anderson, Thomas, M.A., B.Sc., 21 *Granby Road, Edinburgh.*

Dec. 1908. ‡Balfour, F. R. S., M.A., 39 *Phillimore Gardens, Kensington, London, W.*

May 1872. *Balfour, I. Bayley, Sc.D., M.D., F.R.S., F.L.S., *King's Botanist. Professor of Botany, and Keeper of the Royal Botanic Garden, Inverleith House.*

Dec. 1863. †Barnes, Henry, M.D., F.R.S.E., 6 *Portland Square, Carlisle.*

Jan. 1905. *Bell, A. C. M., W.S., *East Morningside House, Clinton Road.*

May 1891. *Berwick, Thomas, 56 *North Street, St. Andrews.*

Feb. 1919. †Blackburne, Cecil Ireland, *Valence, Westerham, Kent.*

May 1888. *Bonnar, William, 51 *Braid Avenue.*

Jan. 1899. *Borthwick, A. W., O.B.E., D.Sc., 46 *George Square, Edinburgh.*

Dec. 1886. *Bower, F. O., M.A., D.Sc., F.R.S., F.L.S., *Professor of Botany, University of Glasgow,* 1 *St. John's Terrace, Hillhead, Glasgow.*

Feb. 1870. †Bramwell, John, M.D., "*The Hove,*" *Furze Hill Road, Torquay.*

April 1913. ‡Brebner, James, 2 *Scotswood Terrace, Dundee.*

Dec. 1906. †Bryce, George, B.Sc., *Botanic Garden, Peradeniya, Ceylon.*

Nov. 1894. Buchan-Hepburn, Bart., Sir A., *Smeaton Hepburn, Prestonkirk.*

Dec. 1915. Cadman, Miss Elsie, M.A., B.Sc., 30 *Trinity Road.*

Feb. 1882. Caird, Francis M., M.B., C.M., F.R.C.S.Ed., *Professor of Clinical Surgery,* 13 *Charlotte Square,*—Artist.

Nov. 1905. Campbell, Robt., M.A., D.Sc., *Geological Department, University of Edinburgh.*

Dec. 1858. †Carruthers, William, F.R.S., F.L.S., *Central House, Central Hill, London, S.E.*

June 1873. *Clark, T. Bennet, C.A., *Newmills, Balerno.*

Dec. 1856. †Cleland, John, M.D., F.R.S., *Drumclog, Crewkerne, Somerset.*

May 1861. ‡Coldstream, Wm., B.A., I.C.S. (retd.), 69 *West Cromwell Road, London, S.W.*

April 1913. ‡Cooper, R. E., *c/o Secretary, Botanical Society of Edinburgh.*

Mar. 1900. *Cowan, Alexander, *Valleyfield, Penicuik.*

Feb. 1870. †Cowan, Charles W., *Dalhousie Castle, Midlothian.*

April 1909. Cowan, Robert Craig, *Eskhill, Musselburgh.*

Mar. 1903. Cowie, William Beaverley, F.C.S., 26 *Clyde Street.*

Dec. 1915. *Craib, W. G., M.A., *Royal Botanic Garden.*

Dec. 1866. *Craig, Wm., M.D., F.R.C.S.Ed., F.R.S.E., 71 *Bruntsfield Place.*

Dec. 1903. Davidson, J. Randolph, M.A., B.Sc., *School of Agriculture, Gizeh, Egypt.*

Dec. 1911. ‡Davidson, John, *Botanical Office, University of British Columbia, Vancouver, Canada.*

Dec. 1892. Day, T. Cuthbert, 36 *Hillside Crescent.*

April 1914. Dodd, A. Scott, B.Sc., 20 *Stafford Street, Edinburgh.*

Jan. 1894. *Dowell, Mrs. A., 13 *Palmerston Place, Edinburgh.*

Dec. 1911. †Drummond, J. R., B.A., F.L.S., F.Z.S., 119 *Twyford Avenue, North Acton, London, W.* 3.

Dec. 1859. †Duckworth, Sir Dyce, Bart., M.D., LL.D., 28 *Grosvenor Place, London, S.W.*

Dec. 1869. †Duthie, J. F., B.A., F.L.S., *c/o The Manager, Delhi & London Bank, Ltd.,* 5 *Bishopsgate, London, E.C.*

Feb. 1917. †Eley, Charles, *East Bergholt Place, Suffolk.*

Nov. 1885. Elliot, G. F. Scott, M.A., B.Sc., F.L.S., *Drumwhill, Mossdale.*

Jan. 1883. *Evans, Arthur H., M.A., 9 *Harvey Road, Cambridge.*

Dec. 1905. *Evans, Capt. W. Edgar, R.A.M.C., T.F., 38 *Morningside Park.*

Mar. 1890. Ewart, J. Cossar, M.D., F.R.S., L. & E., *Professor of Natural History, University of Edinburgh.*

Date of Election.		
Feb.	1894.	Ferguson, Sir R. C. Munro, K.C.M.G., *of Raith and Novar, Kirkcaldy.*
Feb.	1873.	*France, Charles S., 13 *Cairnfield Place, Aberdeen.*
Jan.	1906.	*Fraser, James, 18 *Park Road, Leith.*
July	1872.	*Fraser, John, M.B., C.M., 54 *Great King Street.*
Jan.	1903.	Fraser, J. C., *Comely Bank Nurseries, Edinburgh.*
Mar.	1862.	Fraser, Sir Thomas R., M.D., F.R.S., *Professor of Materia Medica,* 13 *Drumsheugh Gardens.*
Mar.	1871.	*Gamble, James Sykes, M.A., F.L.S., *High Field, East Liss, Hants.*
May	1874.	‡Geikie, Sir Archibald, LL.D., F.R.SS. L. & E., *Shepherd's Down, Haslemere, Surrey.*
Jan.	1887.	*Gibson, A. H., 28 *Dalhousie Terrace.*
May	1903.	‡Gilmore, Dr. Owen, L.R.C.P., L.R.C.S.E., 49 *Acre Lane, Brixton, London, S.W.*
Dec.	1907.	Gourlay, Capt. W. Balfour, M.C., R.A.M.C., 2*nd Lancashire Fusiliers, c/o G.P.O., London.*
Jan.	1889.	*Grieve, James, *Redbraes Nurseries, Broughton Road.*
Dec.	1895.	*Grieve, Sommerville, 21 *Queen's Crescent.*
Feb.	1879.	*Grieve, Symington, 11 *Lauder Road.*
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April	1910.	Harvey, Miss Elsie, 5 *Salisbury Road.*
Jan.	1911.	Hawick, Miss C. M., B.Sc., 10 *Derby Street, Leith.*
Mar.	1913.	†Hayward, Miss Ida M., F.L.S., 7 *Abbotsford Road, Galashiels.*
April	1886.	Hill, J. Rutherford, Ph.C., *Secretary, Pharmaceutical Society,* 36 *York Place.*
Feb.	1878.	†Holmes, E. M., F.L.S., F.R.H.S., *Curator of Museum, Phar. Soc. of Great Britain, Ruthven, Sevenoaks, Kent.*
Feb.	1891.	‡Jamieson, Thomas, 10 *Belmont Street, Aberdeen.*
Dec.	1907.	*Jeffrey, J. Frederick, *Redcroft, Redhill, Wrington, Somerset.*
Mar.	1905.	†Joannides, Pericles, B.Sc., *Sporting Club, Ibrahimieh, Alexandria, Egypt.*
May	1877.	*Johnston, Henry Halcro, C.B., D.Sc., M.D., F.L.S., *Colonel R.A.M.C., Orphir House, Orphir, Kirkwall.*
Dec.	1912.	*Johnstone, James Todd, M.A., B.Sc., *Royal Botanic Garden, Edinburgh.*
Jan.	1874.	*Kirk, Robert, M.D., F.R.C.S.Ed., *Bathgate.*
Dec.	1911.	*Lamont, Miss Augusta, B.Sc., 73 *Falcon Road.*
Jan.	1914.	Latimer, Sydney, 2 *Hermitage Gardens, Edinburgh.*
Dec.	1917.	Law, Mrs. John, 41 *Heriot Row, Edinburgh.*
Feb.	1888.	‡Learmonth, Wm., *Fleetview, Gatehouse of Fleet.*
Feb.	1878.	‡Lennox, David, M.D., F.C.S., *Tayside House, Nethergate, Dundee.*
Jan.	1895.	MacDougall, R. Stewart, M.A., D.Sc., 9 *Dryden Place.*
Jan.	1881.	†Macfarlane, John M., Sc.D., F.R.S.E., *Professor of Botany, University of Philadelphia, U.S.A.*
Feb.	1886.	M'Glashan, D., 11 *Corrennie Gardens.*
June	1880.	*M'Intosh, W. C., M.D., LL.D., F.R.SS. L. & E., F.L.S., 2 *Abbotsford Crescent, St. Andrews.*
Feb.	1914.	Macpherson, Alexander, M.A., B.Sc., 5 *London Street, Edinburgh.*
June	1897.	†Macvicar, Symers M., *Invermoidart, Acharacle, Argyllshire.*
Feb.	1914.	Macwatt, John, M.B., C.M., *Morelands, Duns.*
Oct.	1914.	*Martin, Isa, M.A., 1 *Hampton Place, Edinburgh.*
Jan.	1902.	Massie, William Hall, *Redbraes House, Broughton Road.*
Mar.	1913.	†Matthews, James R., M.A., *Birbeck College, Breams Buildings, London, E.C.*
Feb.	1902.	*Millar, R. C., C.A., 6 *Regent Terrace,*—AUDITOR.
April	1919.	‡Mills, Albert Edward, 8 *George Street, Bath.*
Jan.	1899.	Morton, Alex., B.Sc., 23 *Morningside Grove.*
July	1878.	†Muirhead, George, F.R.S.E., *Gordon Estates Office, Fochabers.*
Oct.	1918.	†Murray, J. M., B.Sc., *Kingswood, Murthly, Perthshire.*
April	1916.	†Nicholson, C., Esq., F.E.S., 35 *The Avenue, Hale End, Chingford, Essex.*
Dec.	1907.	*Orr, Matt. Y., *Royal Botanic Garden, Edinburgh.*
Oct.	1914.	†Patton, Donald, M.A., B.Sc., *Manse Villa, Pollok Road, Shawlands, Glasgow.*
April	1883.	*Paul, Very Rev. David, M.A., LL.D., D.D., *Carridale, Fountainhall Road,*—FOREIGN SECRETARY.
April	1887.	Peyton, Rev. W. W., *Braeriach, Tan-y-Bryn Road, Llandudno, Wales.*
Dec.	1917.	Pike, J. Lyford, B.Sc., *Rosetta, Liberton.*

Date of Election.

Jan. 1915. Pinkerton, A. A., 19 *Shandwick Place, Edinburgh.*
June 1891. †Prain, Sir David, M.D., C.I.E., F.R.S.E. L. & E., F.L.S., *Royal Botanic Gardens, Kew.*
July 1884. *Rattray, John, M.A., B.Sc., F.R.S.E., *Tullyburn Terrace, Glasgow Road, Perth.*
April 1877. ‡Riddell, Wm. R., B.A., B.Sc., (*Hon. Mr. Justice*), *Osgoode Hall, Toronto, Canada.*
Dec. 1869. *Robertson, A. Milne, M.B., C.M., *Hawea, Rodway Road, Roehampton, London, S.W.*
Dec. 1890. Robertson, Robert A., M.A., B.Sc., *Lecturer on Botany, Botanical Department, Bute Medical School, St. Andrews.*
Feb. 1905. *Ross, A. J., M.A., B.Sc., *Schoolhouse, Gretna.*
June 1898. Russell, David, *Rothes, Markinch.*
Mar. 1902. Sampson, Hugh C., B.Sc., *Trichinopoly, Madras, India.*
Dec. 1887. ‡Scott, J. S., L.S.A., 69 *Clowes Street, West Gorton, Manchester.*
Feb. 1891. *Smith, J. Pentland, M.A., B.Sc., *Braedene, Lochwinnoch, Renfrewshire.*
Nov. 1914. Smith, James L. S., M.A., B.Sc., 17 *Cargill Terrace, Trinity.*
Dec. 1917. †Smith, J. T., 68 *Tennant Street, Glasgow.*
Dec. 1909. Smith, Wm. G., B.Sc., Ph.D., 9 *Braidburn Crescent.*
Jan. 1902. *Smith, W. W., M.A., *Royal Botanic Garden, Edinburgh* (6 *Lennox Row, Leith*).—Honorary Secretary.
Jan. 1890. *Somerville, William, Œc.D., B.Sc., F.R.S.E., *Sibthorpian Professor of Rural Economy*, 121 *Banbury Road, Oxford.*
Oct. 1914. †Stewart, Edward J. A., M.A., B.Sc., 8 *Manor Road, Jordanhill, Glasgow.*
Oct. 1918. †Stewart, Capt. William, *Shambellie, Kirkcudbright.*
Dec. 1916. †Stirling-Maxwell, Sir John, Bart., *Pollok, Pollokshaws, Glasgow.*
Feb. 1902. Tagg, Harry F., F.L.S., *Royal Botanic Garden, Edinburgh.*
Jan. 1913. ‡Tagg, M. H., 53 *Clayton Avenue, Wembley, Middlesex.*
Dec. 1887. Terras, J. A., B.Sc., 40 *Findhorn Place.*
Jan. 1909. Thompson, Miss Jean G., B.Sc., 19 *Pentland Terrace.*
Dec. 1888. Turnbull, Robert, B.Sc., *Board of Agriculture, 4 Upper Merrion Street, Dublin.*
July 1886. †Waddell, Alexander, *of Palace, Jedburgh.*
Oct. 1918. †Watson, Harry, *Forestry School, Dunkeld.*
Feb. 1901. Whytock, James, *Dalkeith Gardens, Dalkeith.*
Dec. 1890. *Wilson, John H., D.Sc., F.R.S.E., 39 *South Street, St. Andrews*:—*Associate, Nov.* 1886.
Feb. 1912. Wilson, Malcolm, D.Sc., 31 *Wardie Road, Trinity.*
Mar. 1909. *Wilson, Thos., Ph.C., 110 *High Street, Burntisland.*
May 1873. ‡Wright, R. Ramsay, M.A., B.Sc., *Professor of Natural History, University, Toronto.*
May 1863. *Yellowlees, David, M.D., LL.D., 6 *Albert Gate, Dowanhill, Glasgow.*
Jan. 1903. Young, William, *Fairview, Kirkcaldy.*

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Nov. 1910. Clark, Mrs. Bennett, *Newmills, Balerno.*
Nov. 1910. Grieve, Miss Jean E., 11 *Lauder Road, Edinburgh.*

ASSOCIATES.

Mar. 1886. Bennett, A., F.L.S., 5 *Thanet Place, High Street, Croydon.*
Feb. 1871. Evans, William, F.R.S.E., 38 *Morningside Park.*
Jan. 1906. Harrow, R. L., *Royal Botanic Garden, Edinburgh.*
Feb. 1919. Johnson, Norman M., B.Sc., 17 *Douglas Street, Kirkcaldy.*
Dec. 1883. Richardson, Adam D., 19 *Joppa Road, Portobello, Midlothian.*
Jan. 1906. Stewart, L. B., 23 *Brandon Terrace.*

LADY MEMBERS.

June 1893. Aitken, Mrs. A. P., 15 *Victoria Mansions, West Hampstead, London, N.W.*
April 1893. Balfour, Mrs. Bayley, *Inverleith House.*
Feb. 1910. Galletly, Mrs. Sarah H., 71 *Braid Avenue.*
April 1902. Grieve, Mrs. Symington, 11 *Lauder Road.*

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Date of Election.

Dec. 1905. Adamovic, Lujo, *Professor of Botany, and Director of the Botanic Garden, Belgrade.*
Dec. 1905. Barboza, J. Casimiro, *Director of the Botanic Garden, Oporto.*
Dec. 1905. Beijerinck, M. W., *Professor of Bacteriology, Delft.*
Dec. 1881. Bohnensieg, Dr. G. C. W., *Conservator of the Library of the Museum Teyler, Haarlem.*
Mar. 1881. Caminhoá, Dr. Joaquim Monteira, *Rio de Janeiro.*
Dec. 1905. Campbell, Dr. Douglas Houghton, *Professor of Botany, Stanford University, California.*
July 1879. Cheeseman, T. F., F.L.S., F.Z.S., *Curator of the Museum, Auckland, New Zealand.*
July 1879. Cleave, Rev. W. O., LL.D., *College House, St. Helier, Jersey.*
Dec. 1905. Cockayne, L., Ph.D., F.R.S., 20 *Colombo Street, Wellington, New Zealand.*
June 1902. Constantin, Dr. J., *Director, Jardin des Plantes, Paris.*
Dec. 1905. Coulter, John Merle, *Professor of Botany, University of Chicago.*
June 1902. Cramer, Dr. Carl Eduard, *Professor of Botany, Zurich.*
Mar. 1895. Elfving, Dr. Fredrik, *Professor of Botany in the University, and Director of the Botanic Garden, Helsingfors.*
Dec. 1905. Famintzin, Dr. André, *Emeritus Professor of Botany, and Director of the Botanical Laboratory of the Imperial Academy of Sciences, Petrograd.*
Dec. 1905. Fawcett, William, B.Sc., F.L.S., 76 *Shooter's Hill Road, Blackheath, London, S.E.*
Dec. 1905. Gravis, Auguste, *Professor at the University, and Director of the Botanic Garden, Liège.*
Mar. 1895. Guignard, Léon, Membre de Institut, *Professor of Botany, Paris.*
June 1902. Henriques, Julio A., *Professor of Botany in the University, and Director of the Botanic Garden, Coimbra.*
May 1891. Henry, Augustine, M.D., *Professor of Forestry, Royal College of Science, Dublin.*
Dec. 1905. Kjellman, Dr. Frans, *Professor of Botany in the University, and Director of the Botanic Garden, Upsala.*
June 1902. MacMillan, Conway, *Minnesota.*
Dec. 1905. Macoun, John, M.A., F.L.S., *Dominion Botanist on the Geological Survey, Ottawa.*
June 1902. Maiden, J. H., J.P., F.R.S., *Director of the Botanic Garden, Sydney, N.S.W.*
Dec. 1905. Mattirolo, Dr. Oreste, *Professor of Botany in the University, and Director of the Botanic Garden, Torino, Piedmont.*
Dec. 1905. Miyabe, Dr. Kingo, *Professor of Botany, Hokkaido Imperial University, and Director of the Botanic Garden, Sapporo, Hokkaido, Japan.*
June 1902. Miyoshi, Manabu, *Professor of Botany in the Imperial University, Tokio.*
June 1902. Raunkiär, Christen, *Assistant in the Botanic Garden, Copenhagen.*
Dec. 1905. Rodway, Leonard, C.M.G., *Government Botanist of Tasmania, Hobart.*
Dec. 1905. Schröter, Dr. Carl, *Professor of Botany, and Director of the Botanical Museum, Zürich.*
Nov. 1888. Sully, W. C., *Cape Town.*
May 1876. Terracciano, Dr. Nicolao, *Director of the Royal Gardens, Caserta, Campania.*
Nov. 1888. Tyson, W., *Cape Town.*
Dec. 1905. Vladescu, Dr. Milail, *Professor of Botany at the University, and Director of the Botanic Garden, Bukarest.*
Dec. 1887. Wildpret, H., *Director of the Botanic Garden, Orotava.*
June 1902. Wille, Dr. Johan Nordal Fischer, *Professor in the University, and Director of the Botanic Garden, Christiania.*

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Mexico.

Escuintla, Chiapas,	Director, La Zacualpa Botanical Station.

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Boston, Mass.,	Massachusetts Horticultural Society.
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Cambridge, Mass.,	Gray Herbarium, Harvard University.
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Davenport, Iowa,	Academy of Natural Sciences.
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New York,	Academy of Sciences.
	American Museum of Natural History.
	Torrey Botanical Club.
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South America.

Bogota, Rep. of Colombia, Ministry of Public Works.
La Plata, . . . Museo de La Plata, Rep. Argentina.
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Kieff, ... Société des Naturalistes.
Moscow, . . . Société impériale des Naturalistes.
Petrograd, . . . Hortus botanicus imperialis.
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Upsala, ... Kungl. Vetenskaps Societeten.

Switzerland.

Berne, ... Naturforschende Gesellschaft.
Geneva, ... Conservatoire et Jardin Botaniques.
Zürich, ... Naturforschende Gesellschaft.

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Adam, R. M., iv.
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PRINTED IN GREAT BRITAIN BY NEILL AND CO., LTD., EDINBURGH.

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PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXX

OCTOBER 14, 1915.

R. A. Robertson, M.A. B.Sc., President, in the Chair.

The following gentlemen were elected Office-Bearers for the Session:—

PRESIDENT.

R. A. Robertson, M.A. B.Sc.

VICE-PRESIDENTS.

Alexander Cowan, Esq.
James Fraser, Esq.
Symington Grieve, Esq.
James Whytock, Esq.

COUNCILLORS.

A. W. Borthwick, D.Sc.
Sir Archibald Buchan-Hepburn, Bart.
T. Bennet Clark, C.A.
R. C. Davie, M.A., D.Sc.
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R. Stewart MacDougall, M.A., D.Sc.
Harry Sanderson, Esq.
W. G. Smith, Ph.D., B.Sc.
Malcolm Wilson, D.Sc., F.L.S.

Honorary Secretary—W. W. Smith, M.A.
Curator of Herbarium—W. Caldwell Crawford, M.A., F.R.S.E.
Foreign Secretary—Rev. D. Paul, M.A., LL.D.
Treasurer—Richard Brown, C.A., 23 St Andrew Square.
Assistant-Secretary—J. T. Johnstone, M.A., B.Sc.
Artist—Professor Francis M. Caird, M.B., C.M., F.R.C.S.E.
Auditor—Robert C. Millar, C.A.

LOCAL SECRETARIES.

Aberdeen—Professor J. W. H. Trail, M.A., M.D., F.R.S., F.L.S.
Bathgate—Robert Kirk, M.D., F.R.C.S.E.
Berwick-on-Tweed—Francis M. Norman, R.N.
Birmingham—W. H. Wilkinson, F.L.S., F.R.M.S., Manor Hill, Sutton Coldfield.
Calcutta—Professor S. C. Mahalanobis, B.Sc., F.R.S.E., F.R.M.S., Presidency College.
Cambridge—Arthur Evans, M.A.
Croydon—A. Bennett, A.L.S.
Dundee—Professor P. Geddes, F.R.S.E.
East Liss, Hants—James Sykes Gamble, M.A., C.I.E., F.R.S.
Glasgow—Professor F. O. Bower, Sc.D., F.R.S., F.L.S.
London—William Carruthers, F.R.S., F.L.S.
„ J. F. Duthie, B.A., F.L.S.
„ E. M. Holmes, F.L.S., F.R.H.S.
„ Lieut.-Col. Sir David Prain, M.D., C.I.E., F.R.S., F.L.S., Royal Botanic Gardens, Kew.
Melrose—W. B. Boyd, of Faldonside.
Philadelphia, U.S.A.—Professor John M. Macfarlane, D.Sc., F.R.S.E.
St Andrews—Professor M'Intosh, M.D., LL.D., F.R.S.E.
„ Robert A. Robertson, M.A., B.Sc.
„ J. H. Wilson, D.Sc., F.R.S.E.
Toronto, Ontario—The Hon. W. R. Riddell, B.Sc., B.A.
„ Professor Ramsay Wright, M.A., B.Sc.
Vancouver—M'Taggart Cowan, Esq.

Miss S. J. Wilkie read a paper on Periodicity in Transpiration (see p. 59).

Miss Wilkie also communicated a note on the Influence of Different Media on the Histology of Roots (see p. 76).

A note on the Histology of Gymnosperm Cuttings was read on behalf of Miss F. B. Scott. (*To appear in next issue.*)

Dr. R. S. MacDougall showed three specimens of a very large beetle from Sierra Leone, with a piece of stem of the cashew-nut girdled by the beetle. This beetle fells young *Eucalypti*.

Dr. MacDougall recorded, on behalf of Mr. J. Lyford Pike, the occurrence of the giant wood-wasp (*Sirex gigas*, Linn.) in Douglas Fir logs and in Japanese Larch. This is a new enemy of Douglas Fir.

Dr. MacDougall also exhibited *Megastigmus strobilobius*, Ratz., an enemy of Silver Fir seed. The insect was bred

from seed in which the larvæ were discovered by Mr. J. M. Murray. This is the first recorded case of this enemy in Scotland.

Mr. James Fraser exhibited two Fumarias from West Lothian, new records for the county: *Fumaria purpurea*, Pugsley, and *F. Bastardi*, Bor.

Mr. W. W. Smith showed some new species lately obtained from Western China. These included *Beesia*, a new Ranunculaceous genus, a new *Syringa*, three new species of *Buddleia*, a *Roscoea*, and an *Abelia*.

Mr. W. B. Boyd sent for exhibition a branch of *Abies magnifica*, A. Murr., attacked by *Chermes piceae*.

DECEMBER 9, 1915.

Jas. Whytock, Esq., Vice-President, in the Chair.

The Treasurer, Mr. Richard Brown, C.A., submitted the following Statement of Accounts for the Session 1914–1915:—

Income.

Annual Subscriptions for 1914–1915	£34	15	0
Do. Arrears	1	10	0
Transfer from Life Members' Fund	8	10	1
Transactions sold	5	0	0
Subscriptions to Illustration Fund	10	0	6
Interest on Deposits in Bank	3	9	10
Excess of Expenditure over Income	21	3	2
	£84	8	7

Expenditure.

Printing *Transactions* for 1914–15	£57	18	6
Printing Notices for Meetings, etc.	10	15	0
Rooms for Meetings and Tea	7	18	4
Hire of Lantern	1	4	0
Stationery, Postages, Carriages, etc.	2	7	9
Fire Insurance on Books, etc.	0	5	0
Honorarium to Acting Secretary	4	0	0
	£84	8	7

STATE OF FUNDS.

Life Members' Fund.

Balance of Fund at close of Session 1913–1914 . . .		£101 11 1
Add—Life compositions received		13 13 0
		£115 4 1
Deduct—Transferred to Income		8 10 1
Balance as at close of Session . .		£106 14 0

Ordinary Fund.

Balance of Fund at close of Session 1913–1914	£36 8 11	
Deduct—Decrease during Session 1914–1915	21 3 2	
Balance as at close of Session . .		15 5 9
Total Funds . .		£121 19 9
Being:—Sum in Current Account with Union Bank of Scotland Ltd. .	£1 3 10	
Sum in Deposit Receipt with do.	120 0 0	
Due by Treasurer . . .	0 15 11	
As above . .		£121 19 9

Note.—Subscriptions in arrear, considered recoverable. 1912–13, 15s.; 1913–14, £1, 10s.; 1914–15, £5, 10s.

EDINBURGH, *24th November* 1915.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1914–1915, and have found them correct. I have also checked the foregoing Abstract, and find it correct.

ROBT. C. MILLAR, C.A., *Auditor.*

Miss ELSIE CADMAN, Mr. R. M. ADAM, and Mr. W. G. CRAIB were elected Resident Fellows.

Dr. W. G. SMITH gave a communication on the Vegetation of Ben Ledi, and illustrated his paper with exhibition of models of the regions of vegetation on Ben Ledi and Ben Lawers.

A paper on the Flora of the Orkney Isles was read on behalf of Mr. ARTHUR BENNETT (see p. 54).

Three volumes of coloured illustrations of South African Plants were exhibited on behalf of Mrs. M. CROSSMAN.

Dr. R. C. DAVIE showed specimens of *Melampsora Orchidi-repentis* (Plow.), Kleb., on *Goodyera repens*, Br.

Dr. R. S. MacDougall had two exhibits showing the work of boring beetles—*Trypodendron domesticum*, Er., on Birch and *Argyresthia atmariella*, Banks, on Larch.

FEBRUARY 10, 1916.

Jas. Whytock, Esq., Vice-President, in the Chair.

Mr. F. Kingdon Ward communicated a paper dealing with Plant Associations in N.W. Yunnan (see p. 1).

Mr. Kingdon Ward communicated a further and more detailed paper on the Sino-Himalayan Flora (see p. 13).

Dr. W. G. Smith gave an account of observations on *Calluna vulgaris*, Salisb. There were included observations on the development of new shoots, on the effects of grazing, on seed-dispersal, and on the various methods of burning heather.

Mr. J. C. Adam read a paper giving new records of Mosses for Peebles-shire and West Lothian.

Dr. R. S. MacDougall exhibited specimens of trunk of Ash with the brood-galleries of *Hylesinus crenatus*, Fabr.

Dr. R. S. MacDougall also had an exhibit of Narcissus bulbs with larvæ of *Merodon equestris*.

Mr. W. W. Smith showed specimens of *Parasyringa*, a new genus of the *Oleaceae*, from the Chinese province of Yunnan (see p. 93).

APRIL 13, 1916.

Jas. Whytock, Esq., Vice-President, in the Chair.

Miss Beatrice Campbell M'Pherson was elected a Resident Fellow.

Mr. Charles Nicholson was elected a non-Resident Fellow.

Professor Bayley Balfour communicated a paper on *Rhododendron trichocladum*, Franch., and its Allies (see p. 79).

Professor Bayley Balfour also communicated a paper on *Rhododendron lacteum*, Franch. (see p. 97).

Dr. James Stirton communicated a paper on Mosses from West Ross-shire. (*To appear in next issue.*)

Mr. Arthur Bennett forwarded a note dealing with a hybrid *Potamogeton* new to the British Isles (see p. 105).

Mr. George Forrest and Mr. W. W. Smith gave an account of certain species of *Dracocephalum* lately obtained in S.W. China (see p. 89).

Mr. Charles Nicholson exhibited a series of Narcissus Flies belonging to the genera *Merodon* and *Eumerus*.

Dr. A. W. Borthwick showed some abnormal Larch cones, the abnormality being due to a check in development.

Dr. A. W. Borthwick showed also a shoot of Scots Pine with injury due to some unknown cause, but probably insect attack.

Mr. J. Lyford Pike forwarded an exhibit of *Ernobius mollis*, Linn., on Douglas Fir.

A restricted session of four meetings only was held during 1915–1916.

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BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXI

OCTOBER 12, 1916.

SYMINGTON GRIEVE, Esq., Vice-President, in the Chair.

The Office-Bearers of the preceding year were re-elected for the Session.

Sir ARCHIBALD BUCHAN-HEPBURN proposed a motion that the list of members of the Society be printed, and that all names of alien enemies be expunged from the list. Mr. BENNET CLARK seconded the motion. There was no counter-proposal, and the motion was declared carried.

Mr. H. F. TAGG communicated a paper on the Occurrence of Resin Ducts in the Medullary Rays of the Wood of certain Species of *Burseraceae*.

Mr. W. W. SMITH gave an account of the Royal Botanic Garden, Calcutta, with lantern illustrations.

Mr. JAMES SMALL and Mr. W. W. SMITH exhibited a specimen of *Cavea*, a new genus of the *Compositae*, from the Tibetan border (see p. 119).

Mr. GEORGE FORREST and Mr. W. W. SMITH showed specimens of *Trailliaedoxa*, a new genus of the *Rubiaceae*, from S.W. China.

DECEMBER 14, 1916.

SYMINGTON GRIEVE, Esq., Vice-President, in the Chair.

The TREASURER, Mr. RICHARD BROWN, C.A., submitted the following Statement of Accounts for the Session 1915–1916:—

INCOME.

Annual Subscriptions for 1915–1916	£36	15	0
Do. Arrears	3	5	0
Transfer from Life Members' Fund	8	10	1
Transactions sold	3	7	6
Subscriptions to Illustration Fund	1	5	0
Interest on Deposits in Bank	4	7	8
	£57	10	3

EXPENDITURE.

Printing *Transactions* for 1915–1916; *less* Subscriptions received from Authors, £26, 14s.	£11	15	6
Printing Notices for Meetings, etc.	8	12	0
Rooms for Meetings and Tea	4	11	4
Stationery, Postages, Carriages, etc.	2	12	6
Fire Insurance on Books, etc.	0	5	0
Excess of Income over Expenditure	29	13	11
	£57	10	3

STATE OF FUNDS.

Life Members' Fund.

Balance of Fund at close of Session 1914–1915	£106	14	0
Add—Life compositions received	11	11	0
	£118	5	0
Deduct—Transferred to Income	8	10	1
Balance as at close of Session	£109	14	11

Ordinary Fund.

Balance of Fund at close of Session 1914–1915			£15	5	9	
Add—Increase during Session 1915–1916			29	13	11	
Balance as at close of Session						44 19 8
Total Funds						£154 14 7

Being:—Sum in Current Account with Union Bank of Scotland Ltd. .	£19	2	0
Sum in Deposit Receipt with do.	150	0	0
Due by Treasurer . . .	6	0	1
	£175	2	1
Less Printing Accounts outstanding . . .	20	7	6
As above . .			£154 14 7

Note.—Subscriptions in arrear, considered recoverable: 1914–15, £2, 5s.; 1915–16, £3.

EDINBURGH, 29*th November* 1916.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1915–1916, and have found them correct. I have also checked the foregoing Abstract, and find it correct.

ROBT. C. MILLAR, C.A., *Auditor.*

Sir JOHN STIRLING-MAXWELL, Bart., was elected a non-Resident Fellow.

Mr. GEORGE FORREST gave an address on the Flora of Yunnan, with lantern illustrations. The lecturer dealt with the physical features of the country, with its varied and extensive flora, and with the types of hillmen who inhabit the Alpine areas of the province. Many fine examples of *Primula* and *Rhododendron* were shown in their native habitats.

FEBRUARY 8, 1917.

SYMINGTON GRIEVE, Esq., Vice-President, in the Chair.

Mr. CHARLES ELEY was elected a non-Resident Fellow.

The death of Mr. DANIEL OLIVER, an Honorary British Fellow, was intimated; also the death of Dr. JAMES STIRTON, a Fellow of the Society.

Professor BAYLEY BALFOUR communicated a paper on Rhododendrons of the Irroratum Section (see p. 157).

A paper was communicated on behalf of Mr. R. LLOYD PRAEGER, on *Sedum Praegerianum*, W. W. Sm., with a tentative classification of the section Rhodiola (see p. 107).

Mr. ARTHUR BENNETT recorded the occurrence of *Ceratophyllum demersum*, Linn., in the Orkney Isles (see p. 134), and *Ulex nanus*, Forst., in Caithness (see p. 135).

Mr. WILLIAM EVANS communicated a paper giving some Moss Records for Selkirk, Peebles, and the Lothians (see p. 138).

Mr. WILLIAM EVANS submitted, on behalf of Mr. J. C. ADAM, a list of the Mosses of West Lothian (see p. 123).

Mr. CHARLES NICHOLSON sent for exhibition a Longicorn Beetle, *Callidium violaceum*.

Mr. SYMINGTON GRIEVE exhibited a curious miniature Chinese coffin used by the Buddhists for the burial of small mammals and birds.

Mr. KENNETH HAMILTON sent for exhibition a specimen of a new orchid, *Bulbophyllum Imogeniae*, from Nigeria (see p. 228).

APRIL 12, 1917.

SYMINGTON GRIEVE, Esq., Vice-President, in the Chair.

Professor BAYLEY BALFOUR communicated a paper on the Statistics of the Chinese Rhododendron Flora. (To be published in a future issue.)

Professor BAYLEY BALFOUR also communicated a paper on the Development of Rhododendron Seedlings (see p. 221).

Two other papers by Professor BAYLEY BALFOUR were before the meeting, one on *Rhododendron japonicum*, and one giving diagnosis of new species of Rhododendron, chiefly Western Chinese. (To be published in a future issue.)

Mr. WILLIAM EVANS forwarded a paper on Insect Visitors to *Corallorhiza innata*, Br., and some other Orchids in the Forth District (see p. 136).

A restricted session of four meetings only was held during 1915–1916.

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SESSION LXXXII

OCTOBER 11, 1917.

R. A. ROBERTSON, Esq., M.A., B.Sc., President, in the Chair.

The following gentlemen were elected Office-Bearers for the Session:—

PRESIDENT.

JAMES WHYTOCK, Esq.

VICE-PRESIDENTS.

ALEXANDER COWAN, Esq.
JAMES FRASER, Esq.
SYMINGTON GRIEVE, Esq.
Dr. A. W. BORTHWICK, D.Sc.

COUNCILLORS.

Sir ARCHIBALD BUCHAN-HEPBURN, Bart.
T. BENNET CLARK, C.A.
R. C. DAVIE, M.A., D.Sc.
JAMES GRIEVE, Esq.
J. RUTHERFORD HILL, Esq.
R. STEWART MACDOUGALL, M.A., D.Sc.
R. A. ROBERTSON, M.A., B.Sc.
W. G. SMITH, Ph.D.
MALCOLM WILSON, D.Sc., F.L.S.

Honorary Secretary—W. W. SMITH, M.A.
Curator of Herbarium—W. CALDWELL CRAWFORD, M.A., F.R.S.E.
Foreign Secretary—The Very Rev. Dr. D. PAUL, M.A., LL.D.
Treasurer—RICHARD BROWN, C.A., 23 St Andrew Square.
Assistant-Secretary—J. T. JOHNSTONE, M.A., B.Sc.
Artist—Professor FRANCIS M. CAIRD, M.B., C.M., F.R.C.S.E.
Auditor—ROBERT C. MILLAR, C.A.

LOCAL SECRETARIES.

Aberdeen—Professor J. W. H. Trail, M.A., M.D., F.R.S., F.L.S.
Bathgate—Robert Kirk, M.D., F.R.C.S.E.
Berwick-on-Tweed—Francis M. Norman, R.N.
Birmingham—W. H. Wilkinson, F.L.S., F.R.M.S., Manor Hill, Sutton Coldfield.
Calcutta—Professor S. C. Mahalanobis, B.Sc., F.R.S.E., F.R.M.S., Presidency College.
Cambridge—Arthur Evans, M.A.
Croydon—A. Bennett, A.L.S.
Dundee—Professor P. Geddes, F.R.S.E.
East Liss, Hants—James Sykes Gamble, M.A., C.I.E., F.R.S.
Glasgow—Professor F. O. Bower, Sc.D., F.R.S., F.L.S.
London—William Carruthers, F.R.S., F.L.S.
„ J. F. Duthie, B.A., F.L.S.
„ E. M. Holmes, F.L.S., F.R.H.S.
„ Lieut.-Col. Sir David Prain, M.D., C.I.E., F.R.S., F.L.S., Royal Botanic Gardens, Kew.
Melrose—W. B. Boyd, Faldonside.
Philadelphia, U.S.A.—Professor J. M. Macfarlane, D.Sc., F.R.S.E.
St. Andrews—Professor M'Intosh, M.D., LL.D., F.R.S.E.
„ Robert A. Robertson, M.A., B.Sc.
„ J. H. Wilson, D.Sc., F.R.S.E.
Toronto, Ontario—The Hon. W. R. Riddell, B.Sc., B.A.
„ Professor Ramsay Wright, M.A., B.Sc.

Dr. A. W. Borthwick gave an address on Forestry Operations, with lantern illustrations.

DECEMBER 13, 1917.

James Whytock, President, in the Chair.

The Treasurer, Mr. Richard Brown, C.A., submitted the following Statement of Accounts for the Session 1916–1917 :—

Income.

Annual Subscriptions for 1916–1917	£31	10	0
Do. Arrears	1	10	0
Transfer from Life Members' Fund	9	0	7
Transactions sold	6	0	0
Subscriptions to Illustration Fund	1	0	0
Interest on Funds Invested and in Bank	5	1	9
	£54	2	4

Expenditure.

Printing *Transactions* for 1916–1917 (estimate), £72 ; *less* Subscriptions received from Authors, £25, 1s.	£46	19	0
Printing Notices for Meetings, etc.	5	17	0
Rooms for Meetings and Tea	4	18	0
Hire of Lantern	0	12	0
Stationery, Postages, Carriages, etc.	3	19	3
Fire Insurance on Books, etc.	0	5	0
Honorarium to Secretary's Assistant	2	2	0
	£64	12	3
Excess of Expenditure over Income	£10	9	11

State of Funds.

Life Members' Fund.

Balance of Fund at close of Session 1915–1916	£109	14	11
Add—Life compositions received	10	10	0
	£120	4	11
Deduct—Transferred to Income	9	0	7
Balance as at close of Session	£111	4	4

Ordinary Fund.

Balance of Fund at close of Session 1915–1916	£44	19	8			
Deduct—Decrease during Session 1916–1917	10	9	11			
Balance as at close of Session				34	9	9
Total Funds				£145	14	1
Being :—£100 5 % War Stock, 1929–1947	£95	0	0			
Sum in Current Account with Union Bank of Scotland, Ltd.	14	10	9			
Sum in Deposit Receipt with do.	80	0	0			
Due by Treasurer	10	0	4			
	£199	11	1			
Less Accounts unpaid	53	17	0			
As above				£145	14	1

Note.—Subscriptions in arrear, considered recoverable : 1914–15, £1, 10s. ; 1915–16, £2, 5s. ; 1916–17, £6.

Edinburgh, *6th December* 1917.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1916–1917, and have found them correct. I have also checked the foregoing Abstract, and find it correct.

Robt. C. Millar, C.A., *Auditor.*

Mrs. JOHN LAW and Mr. J. LYFORD-PIKE were elected Resident Fellows.

Mr. J. T. SMITH was elected a non-Resident Fellow.

Dr. BORTHWICK gave an account of certain fungi belonging to the genus *Ceratostoma* or *Ceratostomella*.

The Very Rev. Dr. PAUL communicated an interesting note on the discovery of *Clathrus cancellatus*, Tournf., in Argyllshire. Dr. PAUL also recorded the occurrence in Scotland of *Clavaria aurea* and *C. botrytis* (see p. 301).

Mr. R. A. ROBERTSON delivered his Presidential address, reviewing the task of botanists and scientists at the present time, and emphasised the necessity of an adequate knowledge of chemistry in the solution of biological problems. (To be published in next part.)

FEBRUARY 14, 1918.

JAMES WHYTOCK, Esq., President, in the Chair.

Professor BAYLEY BALFOUR communicated a paper on the genus *Nomocharis* (see p. 273).

Professor BAYLEY BALFOUR also communicated a paper on new autumn Flowering Gentians from China (see p. 246).

Dr. W. G. SMITH and Mr. WILLIAM YOUNG read a paper on the Flora of Glenshee. A large and beautiful series of dried specimens illustrated the paper.

APRIL 11, 1918.

JAMES WHYTOCK, Esq., President, in the Chair.

Mr. T. ANDERSON gave a communication on the Principles of Seed-testing.

A paper on the Vegetation of the Ambleside district of Westmoreland was communicated on behalf of Mr. N. M. JOHNSTON.

Mr. W. W. SMITH exhibited a new *Rhynchanthus* and a new *Phytolacca* from China (see Notes, R.B.G., Edin., xlix (1918).

PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXIII

OCTOBER 10, 1918.

JAMES WHYTOCK, Esq., President, in the Chair.

The Office-Bearers of the preceding year were re-elected for the Session, the office of Treasurer being left vacant.

The PRESIDENT intimated that the following Fellows had died during the past session: Mr. RICHARD BROWN, Treasurer, Mr. W. B. BOYD of Faldonside, Mr. W. C. CRAWFORD, Captain NORMAN, Mr. WILKINSON. Mr. J. C. ADAM, a contributor to the Transactions, died on service.

Mr. J. M. MURRAY, Captain WILLIAM STEWART, and Mr. HARRY WATSON were elected non-Resident Fellows.

Professor BAYLEY BALFOUR communicated papers on Rhododendrons of the Triflorum Series, and Critical Points in Description of Species of Rhododendron and Primula, and also Some New or Rare Primulas.

Mr. JAMES FRASER gave an account of a new Grass, *Koeleria advena*, Stapf (see p. 302).

Mr. ARTHUR BENNETT communicated Notes on the Flora of Caithness (see p. 309), and a paper on *Calamagrostis stricta*, Timm, and *C. strigosa*, Wahl. (see p. 305).

Flowers of *Araujia sericifera*, Brot., with moth captured

by its proboscis, were shown from the Royal Botanic Garden.

Mr. Symington Grieve exhibited specimens of Cucumber showing fusion in its fruit; and also abnormal heads of *Plantago lanceolata*, Linn.

Mr. D. M'Glashan exhibited specimens of *Melilotus arvensis*, Wallr., 12 feet high.

DECEMBER 12, 1918.

James Whytock, Esq., President, in the Chair.

The following Statement of Accounts for the Session 1917–1918 was submitted:—

Income.

Annual Subscriptions for 1917–1918	£27	5	0
Do. Arrears	2	5	0
Transfer from Life Members' Fund	9	5	10
Transactions sold	10	0	6
Interest on Funds Invested and in Bank	7	9	4
Income Tax repaid	1	19	6
	£58	5	2

Expenditure.

Printing *Transactions* for 1917–1918, £43, 11s. 6d.; *less* Subscriptions from Authors, £36	£7	11	6
Printing Notices for Meetings, etc.	6	16	6
Rooms for Meetings and Tea	4	1	0
Stationery, Postages, Carriages, etc.	2	13	8
Fire Insurance on Books, etc.	0	5	0
Honorarium to Secretary's Assistant	2	2	0
	£23	9	8
Excess of Income over Expenditure	£34	15	6

State of Funds.

Life Members' Fund.

Balance of Fund at close of Session 1916–1917	£111	4	4
Add—Life compositions received	5	5	0
	£116	9	4
Deduct—Transferred to Income	9	5	10
Balance as at close of Session	£107	3	6

				Brought forward	£107	3 6
		Ordinary Fund.				
Balance of Fund at close of Session 1916–1917			£34 9 9			
Add—Increase during Session 1917–1918			34 15 6			
				Balance as at close of Session	69	5 3
				Total Funds	£176	8 9
Being:—£100 5% War Stock, 1929–1947			£95 0 0			
Sum in Current Account with Union Bank of Scotland, Ltd.			22 9 8			
Sum in Deposit Receipt with do.			80 0 0			
			£197 9 8			
Less—Net Balance on outstanding Accounts	£15 12 9					
Due to Treasurers	5 8 2					
			21 0 11			
				As above	£176	8 9

Note.—Subscriptions in arrear, considered recoverable: 1915–16, 15s.; 1916–17, £2, 5s.; 1917–18, £7, 15s.

EDINBURGH, *6th December* 1918.—I hereby certify that I have audited the Accounts of the Treasurers of the Botanical Society of Edinburgh for Session 1917–1918, and have found them correct. I have also checked the foregoing Abstract, and find it correct.

ROBT. C. MILLAR, C.A., *Auditor.*

Mr. JAMES WHYTOCK delivered his Presidential Address, giving an interesting retrospect of Sylviculture during the past century, and commenting on the successful introduction of important trees and shrubs during that period.

Mr. ARTHUR BENNETT communicated a paper on *Potamogeton longifolia*, Gay, in England (see p. 312), and also Notes on Dr. Hagström's Critical Researches on Potamogeton (see p. 315).

On behalf of Mr. GEORGE CHESTER, a paper was communicated on Potamogetons in the Canal at Market Harboro', Leicestershire.

Mrs. LAW exhibited an early blossom of *Petasites fragrans*, Presl.

Mr. RUTHERFORD HILL exhibited an example of the Ginger-Beer plant.

FEBRUARY 13, 1919.

JAMES WHYTOCK, Esq., President, in the Chair.

Mr. ANDREW MASON, 23 St. Andrew Square, was elected Treasurer of the Society.

Mr. C. I. BLACKBURNE was elected a non-Resident Fellow, and Mr. N. M. JOHNSON, an Associate Member.

Dr. A. W. BORTHWICK gave a short address on the methods which at present obtain in forest survey. He gave an account of some of the proposals which are at present being put into action with regard to the reafforestation of Scotland. He made the interesting observation that a botanical survey of the areas was found to be one of the most satisfactory foundations for gauging the soil capabilities of the various areas. He further gave an account of the collection of scientific data of growth, etc., in the timber trees of Scotland. On an average it is found that it takes twenty years less to grow sizeable timber in this country than in continental areas. Scotland is found to be superior for timber growing to such an extent that in some cases nearly double the productive capacity is shown.

Mr. H. F. TAGG read a paper on the opening of pine cones, and gave an account of the seed extraction which had been done at the Royal Botanic Garden for the supply of pine seeds to the Board of Agriculture during the war. He gave a most interesting account of the mechanism by which pine seeds are gradually discharged from the cone.

Dr. STEWART MACDOUGALL gave records of the occurrence of *Myelophilus minor* in Scotland (see p. 334), and exhibited the work of *Cryptorrhynchus lapathi* (Linn.) on Willow.

Sir DYCE DUCKWORTH sent for exhibition a portion of the famous Dragon Tree at Oratava, Teneriffe, which he had gathered in 1873, and a Stethoscope made in 1872 of wood of one of the largest trees in the Yosemite Valley, *Sequoia gigantea*.

Sir Dyce Duckworth also sent for exhibition a cone from the classical pine forest at Ravenna, gathered in 1865. After a lapse of ten years he had extracted and planted some of the seeds, which all germinated and grew well. They were transplanted in different parts of Berks and Surrey. Those planted on chalky soil, however, died, but those planted in sandy soil thrived well. One of the best specimens is growing in the garden of the Duke of Newcastle at Ascot, and is 18–20 feet high and in fine condition. A cone from it was also shown.

The Honorary Secretary exhibited *Whytockia*, a new genus of the *Gesneraceae*, the generic name being chosen in honour of the present President of the Society (see p. 338).

A sample of German war tobacco was exhibited on behalf of Colonel MacDougall. It was mostly composed of beech leaves; it also contained beech buds, beech petioles, beech twigs, and pieces of petioles of a species of *Nicotiana*.

APRIL 10, 1919.

James Whytock, Esq., President, in the Chair.

Mr. A. E. Mills was elected a non-Resident Fellow.

Professor Bayley Balfour communicated a paper on *Biltia Vaseyi*, Small, as a type of Rhododendron.

Mr. H. F. Tagg read a paper on the preparation of slide cultures of Moulds for class purposes.

Dr. Borthwick and Dr. Wilson exhibited specimens of the Common Spruce attacked by a species of *Cucurbitaria*.

Dr. Wilson exhibited the following Alpine Rust Fungi, which he had recently discovered on the Perthshire mountains and which are new records for Britain:—

Puccinia septentrionalis, Juel, the aecidial stage on *Thalictrum alpinum*, Linn., and uredospore and teleutospore stages on *Polygonum viviparum*, Linn.

Puccinia borealis, Juel, the aecidial stage on *Thalictrum alpinum*, Linn. The uredospore and teleutospore stages

of this species probably occur on *Anthoxanthum odoratum*, Linn., but have not been found in Britain.

Melampsora alpina, Juel, the aecidial stage on *Saxifraga oppositifolia*, Linn., and uredospore and teleutospore stages on *Salix herbacea*, Linn.

He also exhibited Beads from Greece made from wild oranges.

Mr. H. F. Tagg showed a collection of photographs illustrating the opening of Pine Cones and the Extraction of Seed from them; he also exhibited some museum preparations of Common Moulds, and communicated details of the methods of preservation adopted (see p. 335).

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

VOLUME XXVIII.

INCLUDING SESSIONS LXXXIV.–LXXXVII.

(1919-1923.)

WITH NUMEROUS ILLUSTRATIONS.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY.
1923.

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OF THE

BOTANICAL SOCIETY OF EDINBURGH.

VOLUME XXVIII.

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EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY BY
NEILL & CO., LIMITED.

And to b obtained from the SECRETARY OF THE SOCIETY, *at the Royal Botanic Garden.*

1920.

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TRANSACTIONS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXIV.

The Pharmacopoeia of another Botanical Physician.

By The Hon. William Renwick Riddell, B.Sc., LL.D., etc.

(Read 3rd October 1919.)

In two papers read before this Society, 13th November 1913 and 14th January 1915 (Trans. Bot. Soc. Edin., vol. xxvi, pp. 226 sqq., pp. 411 sqq.), there were enumerated the remedies recommended by Samuel Thomson, founder of the Thomsonian School of Medicine, and by certain of his followers.

It was most natural that many divergencies from the original teaching of the Master would appear in the course of time—anything so fundamental as health and its conservation inevitably leads to divagations from the path laid out by a first discoverer: accordingly we find the textbooks and health manuals purporting to be founded on the teachings of the empiric Thomson differing widely from those of Thomson and from each other.

The subject of the present paper is one of the most valued and best known of these manuals, published at Boston, Massachusetts, in 1836. The book is a 12mo of 176 pages, whose title-page reads as follows:—

"*Every man his own Physician*"

THE VEGETABLE FAMILY PHYSICIAN

CONTAINING

A DESCRIPTION

OF

The Roots and Herbs Common to this Country with their Medicinal Properties and Uses

ALSO

DIRECTIONS

For the Treatment of the Diseases Incident to Human Nature by Vegetables Alone

EMBRACING

MANY VALUABLE INDIAN RECIPES

BY SAMUEL B. EMMONS

BOSTON
GEORGE T. OAKES
Pemberton Hill, opposite the head of Hanover Street
1836

The author was the editor of the Botanical Journal, a monthly magazine published at Boston, Mass., devoted to spreading the doctrines of the Reformed Thomsonian method of cure. He seems to have known considerable about the botany of his district, and most of his descriptions of plants are clear and readily recognisable.

He begins by a description of about 125 plants, adding their medicinal properties; then he enumerates a number of diseases and gives a number of "useful and valuable recipes," almost all of purely vegetable composition. He adds short chapters on Diseases of Children (where, by the way, we miss the familiar "salts and senna" and castor

oil); Collecting and Curing Herbs, Barks, and Roots; the Manufacture of Decoctions, Defusions, and Syrups; the Steam and Vapour Bath (borrowed from the Indians); the Medical Treatment of George Washington's last illness (he was attacked with croup, a bleeder took 12 to 14 ounces of blood from him almost at once, and then two more copious bleedings followed—some 20 to 25 ounces each; a physician came and administered two doses of calomel; next morning another bleeding, making in all 80 to 90 ounces of blood drawn, then 10 grains more of calomel and 5 or 6 grains of tartar emetic, then blisters to the extremities and a cataplasm of bran and vinegar to the throat—and, after all that, the stubborn Father of his Country was so ungrateful as to die); a chapter on Cleanliness follows, and one on the Pernicious Effects of Mercury; a satirical chapter on How to get Dyspepsia, and a chapter on Fevers (which ends thus—"There is no other way to cure a fever but to increase the heat, drive out the cold, open the pores, clear the stomach and bowels, and bring a proper balance in the system; then the patient is in health with no torment left behind," which is as sententious and about as valuable as anything Sydenham ever wrote).

As with the Vermont practitioners whose treatise was discussed in the later of the papers already mentioned, little attention is païd by this author to Thomson's Courses of Physic—Emmons does not even give the formula for the celebrated "Six Numbers"; his system is based to a great extent on Thomson's, but it has a right to the title "Reformed Thomsonian" at all events, if the rather common definition is applied here to the word "Reformed," making it synonymous with "changed."

In the following list Nos. 1–58 are given by Thomson himself; Nos. 59–128 by the Vermont Thomsonian Physicians; Nos. 129 sqq. are given by Emmons—those in the former two lists, but not used by Emmons, are placed in parenthesis. The name given by the author to a plant is in italics, the nomenclature is that of Dr. Asa Gray's Field, Forest, and Garden Botany; for convenience sake all the plants named in the three lists are here classified. It will be seen that Emmons does not employ Nos. 26, 28, 29, 36,

40, 50, 52, 53, 58 of Thomson's list, or Nos. 66, 67, 69, 74, 90, 94, 95, 99, 108, 109, 112, 116 of the Vermont list; but he adds ninety-five plants—he therefore uses 202 plants in all.

Ranunculaceae.—1. *Golden Seal, Indian Paint, Yellow Root*, Hydrastis Canadensis, a powerful tonic, good for jaundice, inflamed eyes, and sore legs.

59. *Goldthread*, Coptis trifolia, a pure intense bitter, promoting digestion and strengthening the system—the root only used. Made into a tea with Live-for-ever (No. 136) is a good gargle.

60. *Black Cohosh, Rattle Weed, Squaw Root, Black Snake Root*, Cimicifuga racemosa, much used in rheumatism and to settle stomach.

129. *Garden Peony*, Paeonia officinalis, the root dried and pulverised, of considerable efficiency in the cure of epilepsy and fits in children.

130. *Liver Wort*, Hepatica triloba, for bleeding at the lungs, consumptions, coughs, and liver complaint, also for jaundice—the roots and leaves made into a tea and drunk cold.

131. *Crowfoot, Yellow Weed*, Ranunculus acris, made into a tea, with brandy, for dysentery (see Nos. 187, 48).

Magnoliaceae. — 61. *Whitewood, Tulip Tree, White Poplar, Whitewood Tree*, Liriodendron tulipifera—bark of both body and root a tonic bitter, useful in dysentery, hysterics, dyspepsia, worms, and general debility; also with Nos. 23, 107, and 162 in erysipelas.

Berberidaceae.—132. *Barberry*, Berberis Canadensis. Root a good bitter tonic, beneficial in fevers, diarrhœa, and dysentery.

133. *Blue Cohosh, Blue Berry, Pappoose Root, Blue Gensing*, Caulophyllum thalictroides. Roots used for rheumatism, dropsy, cramps, epilepsy, etc.; an emmenagogue and useful in specific diseases.

134. *Mandrake, May-Apple*, Podophyllum peltatum, a mild purge, vermifuge, and the juice used in deafness. (This has been adopted as a cholagogue by the regular profession.)

Nymphaeaceae. — 2. *White Pond Lily*, Nymphaea odorata or N. tuberosa, excellent applied to tumors and inflammation to ease pain and promote suppuration.

PAPAVERACEAE.—62. *Celandine,* Chelidonium majus, an ointment made of the root simmered in lard used for many purposes. Good for jaundice given as a "tea alone or with a little chimney soot added." (See No. 21.)

63. *Bloodroot,* Sanguinaria Canadensis, juice good for an emetic, powder used to destroy proud flesh, snuffed up will cure polypus; good for croup, rheumatism, and jaundice.

CRUCIFERAE.—3. *Mustard,* Brassica nigra, used with other plants to make a decoction which "has saved many lives" in dropsy.

4. *Horseradish,* Nasturtium Armoracia, an appetiser and cures colds, coughs, etc.; also useful in jaundice, biliousness, etc.

64. *Raddish,* Raphanus sativus, juice useful in cases of renal calculi.

65. *Cabbage,* Brassica oleracea, a leaf used in making a salve for felons, whitlows, etc.

(66. *Scurvy Grass,* Barbarea praecox.)

135. *Shepherd's Purse,* Capsella Bursa-Pastoris, an astringent good for all kinds of fluxes: in a poultice used for external inflammations, especially erysipelas.

136. *Water-cresses,* Nasturtium officinale, quickens the appetite and purges the blood, "exceeding useful in scrofula and consumptive disorders."

222. (See *post.*)

VIOLACEAE.—137. *Blue Violet,* Viola cucullata, used with Mandrake root and Blood root to make cathartic powders.

CISTACEAE.—138. *Frost Weed, Scabious,* Helianthemum Canadense (or A. corymbosum), relieves chronic diarrhœa, dysentery, dysury, gout, dropsy, etc. Made into a syrup is good for hacking cough and bleeding at the lungs.

HYPERICACEAE.—139. *John's Wort* (the common St. John's wort), Hypericum pyramidatum, in a tea relieves the lungs and breast, removes hysterical, hypochondriacal, and maniacal disorders.

CARYOPHYLLACEAE.—140. *Pink,* "the common garden pink" Dianthus Chinensis (and other species) is "a fine carminative and internal anodyne."

141. *Cockle, Cuckold,* Lychnis Githago, the leaves, seeds, and roots with other ingredients in a tea for erysipelas.

142. *Soapwort,* Saponaria officinalis, "good for the jaundice and obstructions of the liver, and is thought by some to be superior to sarsaparilla for the cure of lues venerea."

143. *Mouse-ear,* Cerastium vulgatum, made into a tea with brandy (forming one-fourth by bulk) good for dysentery.

Portulacaceae.—144. *Purslain* (the common purslane), Portulaca oleracea, should be used as a common drink for epileptic fits, cramps, convulsions, etc.; also the juice with No. 41 in snakebites.

Malvaceae.—145. *Red Rose Willow* (apparently a mere mistake for *Mallow*), Hibiscus Moscheutos (and perhaps other species), "a fine tonic and astringent . . . bracing up weak women."

146. *Marsh Mallow,* Althaea officinalis, a decoction to be given "when the gout attacks the kidneys."

(Tiliaceae.—67. *Basswood,* Tilia Americana.)

Linaceae.—68. *Flaxseed,* Linum usitatissimum, in tea for cholera morbus, etc.

Geraniaceae.—(69. *Wood Sorrel,* Oxalis Acetosella.)

70. *Cranesbill,* Geranium maculatum, valuable "for wounds, ulcers, . . . the lues venerea, . . . cholera infantum, . . . bleeding of the lungs, . . . this root with gentian will cure intermitting fevers more effectually than Peruvian bark."

Rutaceae.—5. *Prickly Ash,* Zanthoxylum Americanum, "a good remedy for chronic rheumatism, . . . produces perspiration, . . . the berries are as good as the bark, . . . good for cold hands and feet, and for fits of the ague."

71. *Rue,* Ruta graveolens, an ingredient in Restorative Bitters with unicorn root, blood root, ginseng, tamarisk (tamarack) bark, nanny bush, devil's bit, Seneca snakeroot, sassafras bark, and golden seal. This made with Jamaica spirits (alias rum) "is celebrated for its fine restorative and strengthening qualities in indigestion, rheumatism, dropsy, pain in the breast, etc."

72. *Lemon,* Citrus Limonium, used in lemonade (the *Orange,* Citrus Aurantium, seems to be used only in the

peel to give a flavour to teas, etc.), either as a refreshing drink or to prevent vomiting.

ANACARDIACEAE. — 6. *Sumach,* Rhus typhina or R. aromatica, makes a gargle for sore throats or sore mouths, an antiseptic, makes good poultices for ulcers, good for hectic fever, scrofula, and lues venerea; used also in dying black and making ink.

RHAMNACEAE.—147. *Buckthorn,* Rhamnus catharticus, an ingredient in a tea to be given in cases of hernia.

CELASTRACEAE.—73. *Bittersweet,* Celastrus scandens, a tea good for liver complaint, will remove spots in the skin, good for cancers—when made into a poultice, good for swellings.

(SAPINDACEAE. — 74. *Striped Maple,* Acer Pennsylvanicum.)

POLYGALACEAE. — 148. *Seneca Snakeroot,* Polygala Senega, an "active stimulus," cures rattlesnake bites, good in croup, pleurisy, catarrh, asthma, coughs, and an effective emmenagogue.

LEGUMINOSAE.—7. *Red Clover,* Trifolium pratense, made into a tea for chlorosis.

75. *American Senna,* Cassia Marilandica, a simple cathartic.

76. *Indigo Weed,* Baptisia tinctoria, valuable for all kinds of ulcers, either as a wash, fomentation or poultice; also internally in gangrene, scarlet fever, sore throat, typhus and putrid fevers.

149. *White Beans,* Phaseolus nanus, a poultice for inflammations and swellings.

223. See *post.*

ROSACEAE.—Plum Family.

10. *Peach,* Prunus Persica, flowers and leaves made into a tea, a vermifuge; the meats in brandy a powerful tonic in debility, chlorosis, fever and ague, etc.; the bark in a tea with brandy, good for weak stomach.

11. *Wild Cherry,* Prunus Pennsylvanica, bark in a strong decoction to be applied to scrofulous tumors; in a tea with brandy for a weak stomach.

80. *Black Cherry,* Prunus serotina, the bark an ingredient in jaundice bitters.

Rose Family, proper.

150. *Hardhack*, Spiraea tomentosa, used to cure wounds.

8. *Avens Root, Chocolate Root*, Geum rivale, a wholesome drink used instead of chocolate, which it resembles in flavour, very strengthening for the sick, used in consumption.

151. *Cinquefoil, Five-finger*, Potentilla Canadensis, the root very beneficial in debility, lassitude, and night sweats.

9. *Red Raspberry*, Rubus triflorus or R. strigosus, frequently eaten, dissolves the tartarous concretions on the teeth.

77. *Blackberry*, R. villosus, the bark an ingredient in an ointment for scald head.

78. *Strawberry*, Fragaria Virginiana, fruit equally efficacious with raspberries in removing calcareous concretions on the teeth: much used in fevers, gout, gravel, scurvy, and consumption, relieves diseases of the bladder and kidneys; as a wash cures chilblains; both plant and leaves employed in tea for sore throat, swelled gums, jaundice, fevers, etc., etc., as cooling and astringent.

79. *Roses*, Rosa, of various species, as a decoction, fomentation or poultice allay inflammation, and as a tea are astringent and tonic.

152. *Agrimony*, Agrimonia Eupatoria, roots excellent for wind in the stomach and create an appetite, given as a powder or an infusion of roots and seeds.

Pear Family.

153. *Hawthorn*, Crataegus Oxyacantha, used with sage (Salvia officinalis) and balm (Monarda punctata or M. didyma) to make British herb tea, "an excellent and pleasant sanative tea, particularly wholesome to nervous people."

81. *Apple*, Pyrus Malus, the cider used for a drink in jaundice.

Saxifragaceae. — 154. *Gooseberry*, Ribes Grossularia the bark in decoction good for gravel; green berries scalded and baked procure appetite; young leaves made into a tea applied as a lotion to allay inflammation.

155. *Black Currant*, Ribes nigrum, bark has the same qualities as that of the gooseberry.

Crassulaceae.—156. *Live-for-ever*, Sedum Telephium,

with sage (Salvia officinalis, No. 97) or gold thread (Coptis trifolia, No. 59), in a tea good for sore throat; the blossoms chewed and the juice swallowed of great benefit in quinsy and sore throat.

HAMAMELACEAE.—12. *Witch Hazel*, Hamamelis Virginica, the leaves made into a tea, excellent for bowel complaints, bleeding at the stomach or lungs; as a snuff, a styptic for nose, etc.; a poultice of the bark removes painful inflammation of the eyes.

(HALORAGEAE.—82. *Marestail*, Hippuris vulgaris.)

CUCURBITACEAE.—157. *Wild Cucumber*, Sicyos angulatus (?) "strengthening, cooling, and nourishing, . . . the fresh root eaten early in the morning affords much relief in consumptive and debilitated cases."

158. *Watermelon*, Citrullus vulgaris, a handful of the seeds put in gin and allowed to stand for a week in a warm place, drink half a wineglassful two or three times a day—this is excellent for renal calculus, gravel, etc.

159. *Pumpkin*, Cucurbita Pepo. Pumpkin seed oil, a valuable remedy for hæmorrhoids.

UMBELLIFERAE.—83. *Carrots*, Daucus Carota, with flour and butter, an excellent application for sores, swellings, ulcers, etc.

160. *Sweet Cicely*, Osmorrhiza longistylis, used in making aromatic bitters.

161. *Caraway*, Carum Carui, German domestic remedy against hysterics.

84. *Parsley*, Carum Petroselinum (Petroselinum sativum), a powerful diuretic.

13. Archangel, called here *Angelica*, Archangelica atropurpurea, roots excellent for wind in the stomach, and cause an appetite.

162. *Masterwort*, Heracleum lanatum, the root ingredient in a brandy decoction for erysipelas with Nos. 14, 107, and the bark of No. 61.

ARALIACEAE.—14. *Gensing*, Aralia quinquefolia, the root with No. 162, etc., for erysipelas; also with No. 119 and nutmegs for St. Vitus's Dance.

85. *Spikenard*, Aralia racemosa, roots and berries in a tea good for coughs, weakness, and a general tonic; bruised and made into a poultice applied to wounds, ulcers, and

ringworms; made into a cordial recommended for gout; the juice for earache and deafness.

86. *Sarsaparilla*, Aralia nudicaulis, in a decoction good for all diseases of the skin, scrofulous sores, rheumatism, gout, mercurial diseases, and lues venerea.

Cornaceae.—87. *Boxwood* or *Dogwood*, Cornus florida, the bark astringent, antiseptic, and stimulant either as a powder or as tea; used also berries, bark, and flowers for fevers and colics; with Sassafras officinale (No. 110) in a poultice to clean foul ulcers.

88. *Green-osier*, Cornus sericea (Kinnikinnik or Indian Tobacco), bark an ingredient in erysipelas tea and cancer tea—(it is possible, however, that the Salix cordata is meant).

Caprifoliacea. — 89. *Elder*, Sambucus Canadensis or S. pubens, flowers in a tea for scurvy and bowel complaints; inner bark in dropsy, diuretic; made into an ointment cures eruptions of the skin; flowers in decoction useful in erysipelatous fevers; the berries for the same purposes as bark and flowers.

(90. *High Cranberry*, Viburnum Opulus.)

163. *Nanny Bush, Black Haw*, Viburnum prunifolium, "the bark is an excellent tonic and is considered superior to Peruvian bark."

Rubiaceae.—15. *Cleavers, Goosegrass*, Galium Aparine, diuretic, crumbles calculi of kidneys or bladder, but "being of a cold nature it is not proper in dropsies or other diseases of cold and debility."

(91. *Partridge Berry*, Mitchella repens.)

164. *White Ball, Butterwood Shrub, Little Snowball, Swampwood, Dogwood, Globe Flower*, Cephalanthus occidentalis, tonic, cathartic, diaphoretic, flowers, leaves, bark of stems and roots; a fine fragrant syrup made of the leaves and roots a mild laxative and tonic; a decoction of the bark of the roots cures intermittent fevers and is useful in diarrhœa.

Valerianaceae.—16. *Valerian*, Valeriana officinalis or V. sylvatica, an excellent medicine in nervous complaints, epilepsies, hysteria, and hypochondria, one or two teaspoonfuls of the powdered root two or three times a day. (This plant is called "White Snake Root" in this work;

that name is more commonly used of the Eupatorium ageratoides.)

COMPOSITAE. — 17. *Frostweed*, Senecio aureus, relieves chronic diarrhœa, dysury, gravel, gout, etc., etc.; used externally in wounds, tumours, etc.

18. *Elecampane*, Inula Helenium, for diseases of the lungs, coughs, asthmas, and consumptions—a good diuretic and diaphoretic, laxative, alterative, and tonic.

165. *Yarrow*, Achillea Millefolium, a detergent, has cured cancer of the breast, stops spitting of blood and dysentery.

166. *Ox-eye, Sneezewort*, Achillea Ptarmica, tonic and febrifuge, produces sneezing; good for headaches, deafness, etc.

19. *Mayweed*, Maruta Cotula, useful in colds, fevers. rheumatism, and asthma; if given with an emetic promotes vomiting; very sudorific; externally used in fomentations.

20. *Wormwood*, Artemisia Absinthium, used in stomach complaints, fevers, dropsy, and jaundice, and as a vermifuge; an antiseptic, as a poultice relieves pain from a bruise, and prevents discoloration and swelling.

167. *Mugwort*, Artemisia vulgaris, a tea given in chlorosis.

168. *Southernwood*, Artemisia Abrotanum, vermifuge, as a salve cures sciatica, gout, and rheumatism.

21. *Tansy*, Tanacetum vulgare, leaves and seed for worms; decoction or juice drunk in wine useful in "stranguary" and in weakness of the kidneys; used in jaundice with Nos. 25 and 62.

22. *Chamomile*, Anthemis nobilis, a cheap and pleasant bitter; flowers excite vomiting when taken in tea; boiled in cow's milk good for diseased eyes; bruised and moistened with vinegar applied to sprains and bruises.

23. *Burdock*, Lappa officinalis, diuretic and diaphoretic, also to purify the blood; seeds good for dropsy, scurvy, rheumatism, gout, inflammation of the kidneys, and lues venerea; leaves good applied to the feet in fevers. The root used with No. 162 for erysipelas.

24. *Thoroughwort, Boneset*, Eupatorium perfoliatum, an intense bitter, an emetic as a warm decoction, a powerful tonic as a cold infusion—the cold infusion in large doses is cathartic, cleanses the stomach and throws off disease;

for colds a complete remedy, useful in indigestion of old people, excellent in bilious colic, etc., in fact it seems as great a panacea as its sister E. purpureum, the famous Joe-Pye weed.

25. *Feverfew*, Chrysanthemum Parthenium, a decoction with celandine and tansy drunk plentifully will cure jaundice.

(26. *Golden Rod*, Solidago nemoralis.)

27. *Wild Lettuce*, Lactuca Canadensis, used as an ingredient in a decoction for curing "canker."

(28. *Bitter Thistle*, Silybum Marianum.)

(29. *Cardis benedictus*, Cnicus benedictus.)

92. *Coltsfoot*, Tussilago Farfara, good for scrofula, a consumptive cough, a warming stimulant, diaphoretic; "a snuff made of the leaves is good for the eyes and head, and the whole plant made into beer is very grateful and medicinal in colds," obstructions, whooping-cough, asthma, pains in the breast, etc.; an infusion is good for the ague.

169. *Marigold*, Calendula officinalis, leaves mixed with vinegar ease pain in any swelling and in inflammations.

170. *Sunflower, Wild Sunflower*, Helianthus giganteus or H. divaricatus, carminative, antispasmodic, and laxative, the most efficacious remedy for bilious colic known.

171. *Garden Sunflower*, Helianthus annus, an ingredient with No. 170 and several other native and foreign plants in "Dr. Hull's Genuine Bilious Physic."

172. *Succory*, Cichorium Intybus, juice "of service in obstructures of the viscera, jaundice, cutaneous eruptions, intestinal weakness, and hypochondriacal affections."

173. *Rattlesnake Root*, Nabalus altissimus or N. albus, in canker in the mouth and intestines, especially in children.

102. *Dandelion*, Taraxacum Dens-leonis, "an excellent article for the real affection of the liver," the roots are bruised and boiled, a good sudorific; also good for the kidneys, a diuretic.

174. *Wild Lettuce*, Lactuca Canadensis, with Cranesbill (No. 70), White Lily or Goldthread (No. 52) in a decoction for canker.

175. *Scabious, Fleabane*, Erigeron Philadelphicum, for chronic diarrhœa, dysury, dropsy, etc.

223. (See *post.*)

LOBELIACEAE.—30. *Lobelia*, Lobelia inflata, a cure-all as with all the Thomsonian School, chiefly as an emetic or clyster.

ERICACEAE.—31. *Pipsissewa, Prince's Pine*, Chimaphila umbellata, "valuable internal medicine for fevers, rheumatism, diseases of urinary organs, scrofula, cancer, dropsy, and nervous debility; externally for bathing rheumatic joints, ulcers, and hard swelling; the tops and roots made into a tea for both internal and external use.

93. *Wintergreen, Checkerberry, Mountain Tea, Deerberry, Spice-berry. Tea-berry, Ground Ivy, Hill-berry*, Gaultheria procumbens, "stimulant, anodyne, astringent, sudorific, milky, and cordial"; in an ointment for blows and bruises; the oil relieves toothache. ("Wintergreen" sometimes means the Pylora genus.)

(94. *Uva Ursi*, Arctostaphylos Uva-ursi.)

(95. *Cranberry*, Vaccinium of different species.)

176. *Black Alder*, Ilex verticillata, berries steeped in wine or brandy an excellent bitter and a good anthelmintic, the bark in a tea good for diseases of the skin, and a good wash for bad ulcers and sores. (The name "Black Alder" is sometimes given to the Silex nigra, but the description given by the author identifies this with the Ilex verticillata or common Winterberry.)

PLANTAGINACEAE.—96. *Plaintain*, Plantago major, the roots and branches with those of the hoarhound (No. 41) bruised and the juice squeezed out, given internally for snake-bites.

OROBANCHACEAE.—177. *Cancer Root, Beech Drops*, Epiphegus Virginiana, a powerful astringent, the fresh bruised root has cured cancer; beneficial in the cure of St. Anthony's Fire; a decoction "a certain cure for wounds, bruises, scalds, and for members nipped by frost."

(PLUMBAGINACEAE. — 33. *Marsh Rosemary*, Statice Limonium.)

PRIMULACEAE. — 178. *Water Pimpernel, Brookweed, Brooklime*, Samolus Valerandi, var. Americanus, in a drink antiscorbutic, diuretic, febrifuge, and an excellent emmenagogue and ecbolic, good also in fevers and coughs.

SCROPHULARIACEAE. — 32. *Snakehead, Brook Aloes*, Chelone glabra, vermifuge.

179. *Brinton Root, Black Root, Bowman Root, Culver's Root,* Veronica Virginica, "the favourite medicine of the famous Indian doctor Hough; he used it to cure disorders of the stomach and bowels, to destroy humours in the blood, to remove costiveness, and to cool fevers"; very useful in pleurisy, typhus, and bilious fevers.

(The author is in error in calling this Bowman's Root, that is Gillenia trifoliata of the Rosaceae, Plum Family.)

180. *Scrofula Plant,* Scrophularia nodosa, in a tea or poultice useful in scrofula or King's-Evil.

34. *Mullein,* Verbascum Thapsus, in a tea sweetened with molasses for hæmorrhoids.

Verbenaceae.—35. *Vervain,* Verbena hastata or V. incisa, an excellent sudorific, used for colds; also a vermifuge and "a good article in gravelly complaints."

(36. *White Vervain,* Verbena urticifolia.)

Labiatae.—181. *Lavender,* Lavendula vera, the flowers with sage (No. 97) and balm (No. 101) to make a British tea as a substitute for foreign tea.

(37. *Spearmint,* Mentha viridis.)

182. *Bugleherb,* Lycopus Virginicus, an excellent astringent, good for bleeding at lungs and stomach.

38. *Peppermint,* Mentha Piperita, a carminative in heartburn.

29. *Pennyroyal,* Hedioma pulegioides, in a tea for chlorosis.

(40. *Summer Savory,* Satureia hortensis.)

41. *Hoarhound,* Marrubium vulgare, with plaintain (No. 96) in snakebites.

183. *Hyssop,* Hyssopus officinalis, for asthma, coughs, and all diseases of breast and lungs.

184. *Thyme,* Thymus vulgaris, a good tonic and stomachic, strengthens the lungs also.

97. *Sage,* Salvia officinalis, "stimulant, carminative, sweating, and tonic . . . excites the appetite," dried leaves made into a tea. The tea taken cold checks night sweats; an ingredient in British Herb Tea. (See No. 181, *supra.*)

98. *Origanum marjoram,* Origanum Majorana, the oil used in toothache dropped on lint and applied to the tooth.

(99. *Rosemary,* Rosmarinus officinalis.)

185. *Heal-all,* Brunella vulgaris, tonic, carminative, diuretic and stimulating, externally applied to sores, swellings, poison, headache, etc.; internally for headache, colic, cramp, dropsy, and indigestion.

100. *Scullcap,* Scutellaria laterifolia, "said to be a specific against the bite of a mad dog . . . long used with great success by a man of the name of Lewis in Westchester County, New York State, for the bite of mad dogs"—administered in a powder made of the dried herb. "Dr. Black, of New York City, says he has cured numbers of chorea or St. Vitus's Dance with one infusion of the herb . . . a good medicine . . . in convulsions, lockjaw, and all cases of nervous irritations."

101. *Balm,* Monarda didyma, an ingredient in British Herb Tea with hawthorn leaves (No. 153) and sage (No. 97.)

186. *Horsemint,* Monarda punctata, the juice "almost a specific for gravel or stone."

103. *Catnip,* Nepeta Cataria, a poultice for swellings, internally for headache, colic, hysterics, worms, and spasms —an emmenagogue, "If catnip was more used than it is, the services of the doctors would be less frequently required."

187. *Ground Ivy* (misprinted "Toy") *Gill,* Nepeta Glechoma, purifies the blood, promotes expectoration, snuffed up the nose cures the headache; good in consumption, jaundice, asthma, kidney complaints; the root ground makes with butternut root (No. 48) and crowfoot root (No. 131) a good poultice for rheumatism and gout.

188. *Motherwort,* Leonurus Cardiaca, relieves hysteria and insomnia, abates delirium and allays spasms, cramps, and convulsions; a good emmenagogue.

189. *Betony,* Betonica officinalis, "if gathered when just going to flower has the taste of tea and all its good qualities without its bad ones, and it, moreover, cures inveterate headaches."

Polemoniaceae. — 190. *Jacob's Ladder,* Polemonium caeruleum, good for the gravel and stone.

Borraginaceae.—104. *Comfrey,* Symphytum officinale, as a syrup good for internal injuries and soreness, diarrhœa, dysentery, etc.; also useful in pulmonary affections, relieving

coughs, etc. The fresh root bruised beneficial when applied to bruises, wounds, ulcers, and all local inflammations.

Solanaceae.—42. *Cayenne*, Capsicum annuum, good for cold hands and feet, rheumatism, etc.; powder sprinkled on old sores dries them up; steeped in brandy or vinegar and applied externally helps colic and dysentery; "cures ague in the face."

191. *Apple Peru*, Nicandra physaloides, leaves simmered in lard a topical application for burns.

43. *Bitter Sweet*, Solanum Dulcamara, a tea good for liver complaint, removes blotches from the face; applied topically is good for cancer and sores of all kinds.

192. *Henbane*, Hyoscyamus niger, in a salve with fresh butter or lard rubbed on the parts affords speedy relief in hæmorrhoids.

193. *Nightshade*, Atropa Belladonna, "Dr. Elisha Smith of New York says that nightshade . . . is almost a specific in the scarlet fever and putrid sore throat and in the black canker so called."

194. *Tobacco*, Nicotiana Tabacum, in a poultice with vinegar for the bite of poisonous reptiles; "a linen rag soaked in sweet oil, butter or lard and sprinkled over with yellow Scotch snuff is said to have performed wonderful cures in the quinsey and croup."

Gentianaceae.—195. *Gentian*, Gentiana quinquefolia and other varieties; an ingredient in Stoughton's Bitters.

196. *Columbo*, Frasera Carolinensis, the root an ingredient in strengthening syrup; "an excellent stomachic and strengthens the system generally."

Apocynaceae.—105. *Indian Hemp*, Apocynum cannabinum, an emetic and cathartic for rheumatism given in prickly ash (No. 5) tea.

Asclepiadaceae. — 44. *Milkweed*, Asclepias phytolaccoides, or A. verticillata (probably the latter), an emetic, cures dropsy; infused in gin useful in gravelly disorders.

106. *Pleurisy Root, Butterfly Weed, Flux Root, Wind Root, White Root*, Asclepias tuberosa, "highly extolled for the cure of pleurisy, difficulty of breathing and all diseases of the lungs, colics, and griping pains in the stomach"; a mild purge.

Oleaceae.—197. *White Ash*, Fraxinus Americana. "The

Indians when bitten (by a snake) after sucking the wound apply a strip of white ash bark above it to prevent the extension of the poison. The bites of spiders and such venomous insects require a similar treatment."

198. *Primhage,* Ligustrum vulgare, the bark an ingredient of cancer tea.

ARISTOLOCHIACEAE.—45. *Canada Snakeroot, Asarabaca,* Asarum Canadense, in a powder with lavender flowers (No. 181) and marjoram leaves (No. 98) dried for a sneezing powder to cause a copious discharge of the mucus; also with coltsfoot (No. 92), bayberry bark (No. 49), and blood root (No. 63) for a catarrh snuff—if wandering milkweed (No. 44) is added it cures the headache.

107. *Virginia Snakeroot, Seneca Snakeroot,* Aristolochia serpentaria, "first introduced in Virginia as a specific for the bite of a rattlesnake," useful also in pleurisies and catarrhs—with Nos. 14, 61, and 162 for erysipelas. (See No. 162.)

PHYTOLACCACEAE.—199. *Garget Poke Root,* Phytolacca decandra, the root as a poultice for swellings, ulcers, and rheumatism; "the juice dried in the sun to a salve has cured cancers"; recommended for the itch, ringworm, etc.

(CHENOPODIACEAE.—108. *Jerusalem Oak,* Chenopodium ambrosioides, var. Anthelminticum or C. Botrys, is repudiated by the author.)

POLYGONACEAE.—(109. *Smartweed,* Polygonum aviculare.)

46. *Curled Dock, Narrow Dock, Sour Dock, Yellow Dock,* Rumex crispus, root purgative, both seeds and root good for dysentery; roots pulverised or bruised made into an ointment or wash good for all diseases of the skin; a decoction used as a drink—excellent for scurvy, bad ulcers, and hard tumours; large doses are emetic.

200. *Sheep Sorrel,* Rumex Acetosella, useful in scurvy and inflammation, leaves roasted applied to tumours, wens, boils, etc., bring them steadily to a head.

201. *Water Dock,* Rumex orbiculatus, a wash for foul ulcers, spongy and putrid gums; internally for scorbutic tumours, rheumatism, and costiveness.

202. *Rhubarb,* Rheum Rhaponticum, a warm stomachic purge useful in gout.

LAURACEAE.—110. *Sassafras*, Sassafras officinale, mucilage from bark leaves and pith useful in dysentery: bark bruised and made up into a poultice with meal, a powerful antiseptic; the oil will generally cure tumours, wens, and inflammations.

203. *Feverbush, Spice Bush*, Lindera Benzoin, cooling and cordial, used by the Indians in all inflammatory complaints.

THYMELEACEAE.—204. *Low Wickup, Moosewood, Leather Bush*. Dirca palustris, "a powerful emetic and cathartic."

URTICACEAE.—47. *Slippery Elm*, Ulmus fulva, the mucilage made from the bark infused in water for dysentery, coughs, pleurisy, quinsy, etc.; useful in poultices for all purposes.

202. *Nettle*, Urtica dioica, leaves and seeds dried made into a snuff, a good remedy for polypus.

111. *Hops*, Humulus Lupulus, an excellent stomachic bitter for dyspepsia, and also in inflammation of the kidneys and gravelly complaints; externally as a poultice made with hot vinegar for all pains, especially spasmodic pains, a poultice or ointment an anodyne to cancers and painful ulcers.

JUGLANDACEAE.—48. *Butternut*, Juglans cinerea, "the bark, particularly that of the root, an excellent cathartic taken in extract pill or cordial." With Crowfoot (No. 131) and ground ivy (No. 187) for rheumatism or gout poultice.

(112. *Hickory*, Carya alba.)

CUPULIFERAE.—113. *White Oak*, Quercus alba, the bark "nearly equal to the Peruvian bark in its tonic and astringent powers. In checking mortification it has succeeded where Peruvian bark had failed"; useful as an infusion topically applied in hernia.

114. *Red Oak*, Quercus rubra, potash made of ashes applied to cancers, the bark used as No. 113; acorns of all oaks roasted used for acorn coffee, a "wholesome, nourishing, strengthening instrument for mankind."

(115. *Beech*, Fagus ferruginea.)

205. *Chestnut*, Castanea vesca, var. Americana, "chewing chestnut twigs and swallowing the juice will give relief" in heartburn.

MYRICACEAE.—49. *Bayberry*, Myrica cerifera, bark of the root made into a tea an excellent remedy for dysentery, pulverised "an excellent sneezing or headache snuff."

(50. *Meadow Fern*, Comptonia asplenifolia.)

(116. *Sweet Gale*, Myrica Gale.)

BETULACEAE.—51. *Black Birch*, Betula lenta, a tea drunk with milk, a galactagogue and emmenagogue. The sap drunk freely good for gravel, to purify the blood and heal canker in the mouth; as a syrup restorative after dysentery.

206. *Swamp* or *Tag Alder*, Alnus incana, bark in a tea good for all diseases of the skin and as a wash for bad ulcers and sores; the "tags" bark and boughs made into a beer cleanse the blood; as an ointment good for bruises and all inflammations.

SALICACEAE.—(52. *White Poplar*, Populus alba.)

(53. *Stinking Poplar*, Populus balsamifera.)

54. *Balm of Gilead*, Populus balsamifera, var. candicans, the buds with several other ingredients boiled into a syrup and sweetened, an excellent stomachic and strengthening syrup.

207. *Red Rod*, *Red Willow*, Salix purpurea, with several other ingredients in a tea "cleanses the system from all cancerous and scrofulous affections."

CONIFERAE.—56. *Hemlock*, Abies Canadensis, the inner bark with bayberry, ginger, cayenne, etc., for "composition powders" to cure colds, rheumatism, "relax," etc.; also the boughs in a tea with other ingredients good for chlorosis.

55. *Balsam Fir*, Abies balsamea, the balsam cures sore nipples.

208. *White Pine*, Pinus Strobus, the bark made into a tea with Seneca snakeroot, burdock seed and prickly ash bark, good for rheumatism.

209. *Tamarisk* (apparently a misprint for *Tamarack*, as this tree is certainly meant), Larix Americana, bark aperient and corroborant, leaves used in jaundice, bleeding at the lungs, and some skin diseases, ulcers, bruises, dropsy; also an emmenagogue.

117. *Cedar*, Thuja occidentalis, "cedar boughs" an ingredient in a tea for chlorosis.

210. *Savine*, Juniperus Virginiana or J. Sabina, var. procumbens, leaves applied externally in powder or in-

fusion to warts, carious bones and old ulcers, itch, gangrene, and scald head; the oil cures toothache.

128. *Juniper*, Juniperus communis, the oil cures toothache. (These species do not seem to be accurately distinguished by this author.)

Araceae.—57. *Skunk Cabbage*, Symplocarpus foetidus, roots and seeds useful in asthma, coughs, consumption, etc.; a good vermifuge when taken in powder.

118. *Wild Turnip, Indian Turnip, Dragon Root, Wake Robin*, etc., Arisaema triphyllum, roots in a tea good for coughs, colds, consumption, cramps in the stomach, quickens the circulation and is a useful stimulant; a poultice made of green roots and leaves useful in scrofula; as an ointment cures scald head.

211. *Sweet Flag*, Acorus Calamus, useful in colic taken as a bitter.

Alismaceae.—212. *Water Plantain*, Alisma Plantago, an astringent in dysentery. The Wyandot Indians use it externally for old sores, bruises, and wounds. "The roots boiled and mashed into a poultice remove inflammation, reduce swelling, cleanse and heal the most foul and inveterate ulcers."

Orchidaceae.—119. *Lady's Slipper, Mocassin Flower, Yellow Umbil, American Valerian, Nerve Root*, etc., Cypripedium pubescens (and other species), a nerve tonic useful in nervous irritation, hysteria, spasms, fits, derangement of the brain, madness and delirium, roots infused.

120. *Crawley Root, Fever Root*, Corallorhiza odontorhiza or C. innata, "cannot be given amiss in any species of colic."

Iridaceae.—213. *Water Flag, Blue Flag, Flower-de-Luce*, Iris versicolor (and probably other species). "Dr Elisha Smith, formerly President of the Society of Botanic Physicians in New York," considered the root a perfect substitute for mercury for any of its purposes.

Chenopodiaceae.—214. *Wormseed*, Chenopodium ambrosioides, oil an anthelmintic. The juice may be administered to children of two or three, or the powdered seeds mixed with molasses.

215. *Garden Beet*, Beta vulgaris, with hoarhound, spikenard, elecampane roots, a honey syrup for coughs and consumption.

LILIACEAE.—(58. *Wake Robin*, Trillium erythrocarpum.)

N.B.—This author calls the Indian Turnip (No. 118) Wake Robin.

121. *Beth Root*, Trillium grandiflorum, the root astringent and tonic; the Indians use it also to cure snakebites.

122. *Red Beth Root*, Trillium erectum, a snuff stops bleeding at the nose.

122. *Unicorn Root, Blazing Star, Star Root*, Helonias bullata, root is used as a tonic and corroborant, an ecbolic and an "excellent female bitter." ("Blazing Star" is in my experience usually applied to the Devil's Bit, No. 216, or to the Liatris Squarrosa or L. cylindriaca.)

216. *Devil's Bit*, Chamaelirium luteum, the root a good astringent and tonic, cures scrofula and makes a good gargle for putrid sore throat (Diphtheria).

127. *Saffron*, Colchicum autumnale, a "stimulant to guard the stomach" in gout.

217. *Dogtooth Violet*, Erythronium Americanum, used as the Iris versicolor (No. 213).

218. *Garlic*, Allium sativum, "two ounces infused in a bottle of Madeira wine and a glassful taken night and morning is a good remedy" for coughs.

219. *Onion*, Allium Cepa, roast in the fire, squeeze out the juice and sweeten with honey, molasses, or sugar," an excellent remedy for coughs in teaspoonful to tablespoonful doses." The juice of red onions is almost a specific for gravel and stone.

123. *Solomon's Seal*, Polygonatum giganteum or P. biflorum, the root a mild and very healing restorative in consumption, general debility, etc., used in syrup, tea, or cordial. The mucilage of the roots is good in inflammation and hæmorrhoids applied as a poultice. (It may be that the author means the *False Solomon's Seal*, Smilacina bifolia, trifolia, stellata or racemosa, all of which I have heard called *Solomon's Seal*.)

GRAMINEAE.—124. *Oats*, Avena sativa, a fomentation made of oats fried in vinegar used in colic applied to the pit of the stomach.

220. *Wheat*, Triticum vulgare, used in flour; also the bran stirred in coffee, tea, or milk a certain remedy for costiveness.

221. *Indian Corn*, Zea Mays, the meal used as a poultice covered with young hyson tea laid on burns will generally perform a cure by one application.

Filices.—125. *Winter Brake*, Pteris aquilina, a powerful astringent, "good to bind blood vessels and to prevent the leaking of sinews."

There is not much, if any, doubt as to the foregoing identifications; I am not sure of the following.

222. *Sciatica Cresses*, Nasturtium palustre of the Cruciferae made into a salve with lard and applied to the hip will cure sciatica and gout, equally effective in rheumatism.

223. *Tory Weed, Canada Burr*, Desmodium of various species of the Leguminosae, the leaves allay inflammation and extract "the soreness and virulence from irritated, galled or bruised parts."

(This may be Bidens frondosa of the Compositae.)

I cannot even guess at *Rupturewort, Camwood, High Wickup, Septfoil, Vine Maple, Castor.*

No more than the writers formerly quoted does this writer confine himself to native plants, although the whole system is based upon the theory that the Almighty has provided in the plants of a country a complete remedy for any disease which can appear in the country. Nor indeed are remedies from the animal or even the mineral kingdom excluded.

Of exotic plants we find young hyson tea, copaiva (the balsam), coffee, cinnamon, ginger, camphor, assafoetida, myrrh, black pepper, nutmegs, guiacum, galbanum, bergamot, cardamon, aloes, allspice, mace, cloves, jalap, cork (the ashes), olive (the oil). Certain vegetable products are also used, gin, rum, brandy, "spirits," turpentine, charcoal, rosin, white rosin, molasses, sugar, tar, black pitch, port wine, vinegar, castile soap, pearl ash.

The animal kingdom is drawn upon for honey, lard, eggs, yellow wax, suet (beef and mutton) spermaceti, beef's gall, black snake's skin ("procure a black snake's skin and tie it round the patient's waist, the flesh side next to the skin, and wear it continually," a perfect preventative against epileptic fits, cramps, and convulsions). Rattlesnake oil ("rattlesnake's oil, four or five drops given on sugar has saved life when the breath was almost totally

stopped" with croup. "It cuts up the phlegm and frees the passages almost instantaneously," and is equally effective in "hooping cough"). Fishworms ("an ointment of fishworms simmered in linseed oil till they crisp and the liquid applied is very powerful in cases of rheumatism").

The mineral kingdom supplies quicklime, caustic potash, ammonia, sal ammoniac, verdigris, alum, chalk, magnesia, rock salt, copperas, saleratus, sulphur, borax.

While our author was a Botanical Physician, he was not bigoted.

Additions to the Flora of Orkney, as recorded in Watson's "Topographical Botany," Second Edition (1883). By Colonel H. H. Johnston, C.B., C.B.E., D.Sc., F.R.S.E., F.L.S.

(Read 10th June 1920.)

This paper forms a continuation of two papers on the same subject, one of which I read before the Scottish Natural History Society on 4th April 1895, and which was published in "The Annals of Scottish Natural History," July 1895, and the other before the Botanical Society of Edinburgh on 15th January 1914, and which was published in the Society's "Transactions," vol. xxvi, pp. 207–217 (1914). Most of the plants mentioned in this paper were collected by me during the years 1914, 1916, and 1919.

Before and after the publication of the second edition of Watson's "Topographical Botany," in 1883, several of the plants mentioned in the following list have been recorded from Orkney by me and other botanists; but, as the value of botanical records is greatly enhanced by the possession of authentic specimens, I have included in this list the names of all specimens in my herbarium, which are either additional to or confirm doubtful records of the plants recorded from County No. 111 Orkney in the second edition of the above-mentioned book.

In the case of those plants which have already been recorded from Orkney, references are given in the following list, under each species and variety, to the books in which

the records have been published. These records are principally contained in "A Tour through some of the Islands of Orkney and Shetland," in the year 1804, by Patrick Neill (1806); "Notice of some of the rarer Plants observed in Orkney during the Summer of 1849," by John T. Syme, Esq., published in the "Transactions of the Botanical Society of Edinburgh," vol. iv, pp. 47–50 (1850); "Florula Orcadensis—A list of plants reported to occur in the Orkney Isles," by H. C. Watson, Esq., F.L.S., published in the "Journal of Botany," No. xiii, pp. 11–20 (January 1864); Annual Reports of the Botanical Exchange Club of the British Isles; "A new List of the Flowering Plants and Ferns of Orkney," edited by W. A. Irvine Fortescue, and published in "The Scottish Naturalist" (1882–1884); "Supplement to Topographical Botany, ed. ii," by Arthur Bennett, A.L.S. (1906); and "Flora Orcadensis," by Magnus Spence, F.E.I.S. (1914).

The nomenclature followed is that of the second edition of Watson's "Topographical Botany" (1883), except in the case of species and varieties which are not recorded in that work. In the latter case the nomenclature adopted is that of "The London Catalogue of British Plants," tenth edition (1908). Non-native plants, which have become naturalised in Orkney, are distinguished by a * prefixed to the names, and the names of casuals are printed in italics.

Of the 54 species and varieties recorded from Orkney in the following list, 36 are native, 6 are naturalised, and 12 are mere casuals introduced into Orkney through the agency of cultivation.

Abbreviations.

"Annals Scot. Nat. Hist." = The Annals of Scottish Natural History.
Bennett, "Suppl. Top. Bot." = Supplement to H. C. Watson's Topographical Botany, second edition. By Arthur Bennett, A.L.S. (1905).
"Bot. Exch. Club Report" (separate Reports by the Secretary and Distributor) = Report of The Botanical Exchange Club of the British Isles, at present called The Botanical Exchange Club and Society of the British Isles
"Journ. Bot." = The Journal of Botany.
"Lond. Cat." = The London Catalogue of British Plants.
Neill, "Tour" = A Tour through some of the Islands of Orkney and Shetland, in the year 1804. By Patrick Neill, A.M., Secretary to the Natural History Society of Edinburgh (1806).

"Scot. Nat."=The Scottish Naturalist.
Spence, "Flora Orcadensis"=Flora Orcadensis, by Magnus Spence, F.E.I.S. (1914).
Watson, "Top. Bot."=Topographical Botany, second edition. By H. C. Watson (1883).

Corrections.

In "Annals Scot. Nat. Hist.," July 1895, p. 176, *for* "Alchemilla vulgaris, *Linn., var.* montana," *read* Alchemilla minor, *Huds., subsp.* filicaulis, *Lindberg* (*fide* E. F. Linton). [=A. vulgaris, *Linn. var. c.* filicaulis (*Buser*), of "Lond. Cat.," ed. x, (1908).]

In "Trans. Bot. Soc. Edin.," vol. xxvi, p. 209 (1914), *for* "Rosa canina, *Linn., var.* sphaerica (*Gren.*) (*fide* J. G. Baker)," *read* Rosa glauca, *Vill., var. d.* transiens (*Kern.*) (*fide* W. Barclay); and *for* "Rosa glauca, *Vill., var.* Crépiniana (*Déségl.*) (*fide* J. G. Baker)," *read* Rosa tomentosa, *Sm.* (*fide* W. Barclay).

[The same corrections should be made in Spence, "Flora Orcadensis," pp. 128 and 129 (1914).]

In "Trans. Bot. Soc. Edin.," vol. xxvi, p. 219 (1914), *for* "Rosa canina, *Linn., var.* lutetiana (*Léman*) (*fide* J. G. Baker)," *read* as follows:—(1) Rosa glauca, *Vill., var. a.* Reuteri (*Godet*) (*fide* W. Barclay). Crags at burnside, Wart Hill, Hoy, 28th August 1883, H. H. Johnston [the same correction should be made in "Annals. Scot. Nat. Hist.," July 1895, p. 176]; and rare on banks at burnside, 240 feet above sea-level, The Dale, between the Hill of Miffia and Cringla Fiold, Stromness, Mainland, 26th August 1912, H. H. Johnston; and (2) Rosa glauca, *Vill., var. e.* subcristata (*Baker*) (*fide* W. Barclay). Common on grassy cliffs at the seashore, 10 feet above sea-level, west side of Aith Hope, Waas, Hoy, 4th August 1913, H. H. Johnston. Native at all these three stations.

In "Annals Scot. Nat. Hist.," July 1895, p. 176, in line 18 from top of page, *for* "*Var.* dumalis (*fide* J. G. Baker)," *read var.* subcristata (*fide* W. Barclay). [The same correction should be made in "Bot. Exch. Club Report for 1880," p. 31 (1881), in line 9 from top of page—the late Dr J. T. I. B. Boswell's record for this plant from Lerquoy Burn, Orphir, Mainland, in 1875.]

In "Trans. Bot. Soc. Edin.," vol. xxvi, p. 211 (1914), *for*

"Hieracium silvaticum, *Gouan, var.* tricolor, *W. R. Linton* in "An Account of the British Hieracia," 1905, p. 39," *read* Hieracium rubicundum, *F. J. Hanbury, var. b.* Boswelli (*Linton*), in "Journ. Bot.," vol. xxxi, June 1893, pp. 178 and 179 (as a species). [A similar correction should be made in Spence, "Flora Orcadensis," p. 131 (1914).]

In "Annals Scot. Nat. Hist.," July 1895, p. 181, in line 3 from bottom of page, *for* "Native" *read* Not native. [The Timothy-grass is cultivated in Orkney, and I have only seen it growing in cultivated fields, or on the borders of cultivated land.]

Class I.—Dicotyledons.

Ranunculus diversifolius, *Gilib., var. b.* Godronii (*fide* J. Groves).—Mud at bottom of shallow water in a small loch, 10 feet above sea-level, Tarf Loch, Swona, 28th July 1914, Henry Halcro Johnston: and swamp near the centre of the island, 50 feet above sea-level, Swona, 28th July 1914, H. H. Johnston. Native and rare at both stations.

Ranunculus hederaceus, *Linn.* (name confirmed by J. Groves).—Mud in bed of a small dried-up pool of water, 110 feet above sea-level, near Backaquoy, north of Castle of Burwick, South Ronaldsay, 20th July 1914, H. H. Johnston: and mud in a ditch, 10 feet above sea-level, Burwick Loch (now a swamp), South Ronaldsay, 20th July 1914, H. H. Johnston. Native and rare at both stations. See "Scot. Nat.," No. xlvii, July 1882, p. 321, where this species is recorded from Papa Westray, by A. R. Duguid, and Quendale in Rousay, by R. Heddle.

Cochlearia groenlandica, *Linn.* (*fide* Arthur Bennett).—Short natural pasture near edge of sea cliffs, 250 feet above sea-level, Black Craig, Stromness, Mainland, 26th May, 10th July, and 4th August 1919, H. H. Johnston. Native. Common. Stem leaves stalked. Petals pale purplish-white, or more rarely white, in different plants. Fruit obovoid, or globose-obovoid, glabrous, wrinkled, brown; persistent style short, glabrous, brown. Confirms the record of this species from Orkney in "Guide to the Orkney Islands" by Rev. Charles Clouston, p. 58 (1862),

and that of the Rev. E. S. Marshall from the Black Craig, Stromness, Mainland, in "Journ. Bot.," vol. xxxix, August 1901, p. 267.

Reseda lutea, Linn.—Gravelly ground round filter beds, Kirkwall Waterworks Reservoir, near Hatston, Saint Ola, Mainland, 31st August 1916, H. H. Johnston. Not native. One plant only seen by me.

Cerastium subtetrandrum, *Murbeck* (*fide* Arthur Bennett).—Turf on igneous rocks, 10 feet above sea-level, Black Holm, near Copinsay, 22nd August 1916, H. H. Johnston. Native. Common. Sepals 4 or 5, petals 4 or 5, and capsule slightly curved or nearly straight, with 8–10 teeth, in the same plant. With reference to my specimens of this plant, Mr Arthur Bennett, in a note dated 7th November 1919, writes: "Not *tetrandrum*—sepals acute and capsule nearly straight; or it might be *pentandrum*, a variety of *triviale*, but I think not. The length of the capsule will not do for *tetrandrum*. It seems to me to agree fairly well with Lindman's figure of *C. subtetrandrum*, Murbeck, = *C. pumilum*, Curt., *var. s.* Lange." A new record for this species for H. C. Watson's county No. 111 Orkney.

Sagina apetala, *Ard.* (*fide* Arthur Bennett).—Natural turfy pasture at seashore, 10 feet above sea-level, Ayre Loch, Copinsay, 22nd August 1916, H. H. Johnston. Native. [I have a specimen of Sagina maritima, *Don* (*fide* Arthur Bennett), collected by me at the same station and on the same date.] Confirms the record of this species for H. C. Watson's county No. 111 Orkney, by Mr Patrick Neill in his "Tour," p. 185 (1806).

Claytonia siberica, Linn. (name confirmed by Arthur Bennett).—Roadside, 150 feet above sea-level, Binscarth, Firth, Mainland, 6th September 1919, H. H. Johnston. Not native. Escape from Binscarth plantation of trees.

Ononis arvensis, Linn. [= *O. repens*, Linn.] (*fide* Arthur Bennett).—Roadside, 25 feet above sea-level, Skaill, Sandwick, Mainland, 6th August 1919, H. H. Johnston. Not native. Rare. Petals pink. On visiting Skaill on 27th September 1919 I found no fruit on the growing plants. See "Annals Scot. Nat. Hist.," No. 26, April 1898, p. 105; and "Trans. Bot. Soc. Edin.," vol. xxvii, p. 55 (1916).

Melilotus officinalis, Willd. [=*M. altissima*, Thuill.]—Gravelly ground round filter beds, 260 feet above sea-level, Kirkwall Waterworks Reservoir, near Hatston, Saint Ola, Mainland, 31st August 1916, H. H. Johnston. Not native. Common. Petals yellow. See Spence, "Flora Orcadensis," p. 19 (1914), where this species is recorded from Quoybelloch in Deerness, and Saint Ola, both in Mainland, and "introduced in both cases." Dr. J. S. Flett reported it from Orkney in 1890.

Lotus major, Scop. [=*L. uliginosus*, Schkuhr.] (*fide* Arthur Bennett).—Pasture near a turnip field, 120 feet above sea-level, junction of the Kirkwall-Stromness Road and Firth-Harray Road, Binscarth, Firth, Mainland, 5th August 1914, H. H. Johnston. Not native. Rare. The fruit did not ripen in 1914, the pods being still unripe on 6th October 1914.

*Lupinus nootkatensis, *Donn.*—Heath, 200 feet above sea-level, Swanbister, Orphir, Mainland, 6th June and 17th August 1914, H. H. Johnston; heathery hillside, 180 feet above sea-level, Grindally, Midland Hill, Orphir, Mainland, 9th June and 15th August 1914, H. H. Johnston; heath, 140 feet above sea-level, Hillside, Stromness, Mainland, 31st May and 11th July 1919, H. H. Johnston; heath, 230 feet above sea-level, Redland Hill, Stromness, Mainland, 15th August 1919, H. H. Johnston; grassy banks at burnside, 60 feet above sea-level, Beaquoy, Birsay, Mainland, 9th July 1919, H. H. Johnston; and heath, 120 feet above sea-level, Hobbister, Stenness, Mainland, 15th July and 18th August 1919, H. H. Johnston. Naturalised and common at all these six stations, where the Lupines are exterminating the native plants. See "Trans. Bot. Soc. Edin.," vol. xvi, p. 166 (1884); "Bot. Exch. Club Report for 1886," p. 146 (1887); "Scot. Nat.," No. xvii, new series, July 1887, p. 129; "Annals Scot. Nat. Hist.," July 1895, p. 176; and *ibid.*, No. 26, April 1898, p. 105, in all of which books this species is erroneously recorded as "Lupinus perennis, *Linn.*" See also "Trans. Bot. Soc. Edin.," vol. xxvi, p. 208 (1914); and Spence, "Flora Orcadensis," p. 16 (1914).

Alchemilla minor, *Huds. subsp.* filicaulis, *Lindberg* (*fide* E. F. Linton) [=A. vulgaris, *Linn.*, *var. c.* fili-

CAULIS (*Buser*), of "Lond. Cat.," ed. x (1908)].—Hilly pasture and burnside, Midland Hill, Orphir, Mainland, 29th July 1876 and 5th June 1877, respectively, H. H. Johnston. Native. The same specimens were identified as "A. VULGARIS, *Linn., var. b.* MONTANA, *Willd.*," by the late Dr. J. T. I. B. Boswell, but the Rev. E. F. Linton informs me that the *var.* MONTANA, *Willd.*, is not found in Great Britain. See "Annals Scot. Nat. Hist.," July 1895, p. 176; and "Journ. Bot.," vol. lii, November 1914, p. 228, in which "A. MINOR, *Huds., var.* filicaulis, *Buser*," is recorded for H. C. Watson's county No. 111 Orkney.

ROSA MOLLIS, *Sm. var. c.* COERULEA, *Woods* (*fide* W. Barclay). — Banks at burnside, Mill Burn, Hoy, 20th August 1885, H. H. Johnston. Native. Confirms the record of this variety from Orkney (South Burn of Quoys, Hoy) by Dr. J. T. I. B. Boswell, in "Bot. Exch. Club Report for 1880," p. 30 (1881). See "Scot. Nat.," No. xlviii, October 1882, p. 363; and Spence, "Flora Orcadensis," p. 21 (1914).

ROSA GLAUCA, *Vill., var. d.* TRANSIENS (*Kern.*) (*fide* W. Barclay).—Heathery banks at burnside, 180 feet above sea-level, Berriedale, Hoy, 4th November 1913, H. H. Johnston. Native. The same specimen was identified as "R. CANINA, *Linn., var. c.* SPHAERICA (*Gren.*)" by Mr. J. G. Baker, and so recorded by me in "Trans. Bot. Soc. Edin.," vol. xxvi, p. 209 (1914); and in Spence, "Flora Orcadensis," p. 128 (1914). See "CORRECTIONS."

EPILOBIUM PARVIFLORUM, *Schreb.* (*fide* Arthur Bennett). —Wet ditch, 120 feet above sea-level, Upper Braebuster, Deerness, Mainland, 19th August 1916, H. H. Johnston. Native. Very rare. Confirms Dr. Macnab's record of this species for H. C. Watson's county No. 111 Orkney. See "Scot. Nat.," No. xlviii, October 1882, p. 364; Bennett, "Suppl. Top. Bot.," p. 35 (1906); and Spence, "Flora Orcadensis," p. 23 (1914).

*Epilobium hirsutum, *Linn.* (name confirmed by Arthur Bennett).—Mud at bottom of shallow running water in a burn, 5 feet above sea-level, Newhouse, Clestrain, Orphir, Mainland, 21st August 1914. Naturalised. Common. No fruit developed in 1914, there being only undeveloped ovaries on the plants growing at this station on 2nd

October 1914. Mr. Peter Goudie, Newhouse, informed me, on 21st August 1914, that this plant escaped from his garden at Newhouse about or before 1908, since which time it has become thoroughly naturalised in the burn between his house and the mouth of the burn at the sea-shore. Confirms the record of this species from Orkney in "History of the Orkney Islands," by Rev. Dr. Barry, ed. ii. p. 280 (1808). See "Trans. Bot. Soc. Edin.," vol. xxvii, p. 55 (1916).

Saxifraga stellaris, *Linn.* (name confirmed by Arthur Bennett).—Wet, mossy rocks on hillside, 500 feet and 800 feet above sea-level, Hoy, 15th June and 11th September 1914. H. H. Johnston. Native. Very rare. See "Scot. Nat.," No. xlviii, October 1882, p. 365; and Spence, "Flora Orcadensis," p. 25 (1914).

*Carum Carui, *Linn.* (name confirmed by Arthur Bennett).—Old artificial pasture, 70 feet above sea-level, Biggings, North Parish, South Ronaldsay, 29th July 1914, H. H. Johnston. Naturalised. Common. This species was found in "meadows below Cletts," near Biggings, South Ronaldsay, by R. Heddle, prior to 1858, and it has grown there, flowering and fruiting freely ever since. See "Scot. Nat.," No. xlviii, October 1882, p. 365; and Spence, "Flora Orcadensis," p. 27 (1914).

Sium angustifolium, *Linn.* [=S. erectum, *Huds.*] (name confirmed by Arthur Bennett).—Marshy burnside, 10 feet above sea-level, Burn of Sutherland, Burray, 27th July 1914, H. H. Johnston. Native. Common. Confirms the record of this species from Orkney by Mr. Patrick Neill in his "Tour," p. 185 (1806). See "Journ. Bot.," No. xiii, January 1864, p. 20; "Scot. Nat.," No. xlviii, October 1882, p. 366; Bennett, "Suppl. Top. Bot.," p. 42 (1906); and Spence, "Flora Orcadensis," p. 28 (1914). Removes "[111 Neill, 'common']" from among the "supposed errors" in Watson, "Top. Bot.," ed. ii, p. 193 (1883).

Scandix Pecten-Veneris, Linn.—Rousay, 1847, Robert Heddle; corn-field, Hoy, 9th July 1877, H. H. Johnston; and potato-field and turnip-field, Myrland, Deerness, Mainland, 23rd August 1916, H. H. Johnston. Not native. A weed of cultivation. Confirms the record of this species from Orkney in "History of the Orkney

Islands," by Rev. Dr. Barry, ed. ii, p. 279 (1808). See "Journ. Bot.," No. xiii, January 1864, p. 14; "Scot. Nat.," No. xlviii, October 1882, p. 366; and Spence, "Flora Orcadensis," p. 30 (1914).

Galium Mollugo, Linn., var. c. *Bakeri*, Syme (*fide* Arthur Bennett).—Patch of artificial pasture, 4 feet long by 3 feet broad, left unploughed in a *bere* (barley) field by Mr. William Delday to prevent the extinction of this plant, 160 feet above sea-level, Quoybelloch, Deerness, Mainland, 19th August 1916; and rare on a grassy bank at roadside, 55 feet above sea-level, Downatown, Birsay, Mainland, 22nd September 1919, H. H. Johnston. Not native. A weed of cultivation. Leaves 6 in a whorl. Corolla white.

Crepis virens, Linn. [= *C. capillaris*, Wallr.] (*fide* Arthur Bennett).—Artificial grass-field, 10 feet above sea-level, Garson, Stromness, Mainland, 5th September 1919, H. H. Johnston. Not native. A weed of cultivation. Common. Confirms the record of this species under the name of "CREPIS *Tectorum*," Sm., in "History of the Orkney Islands," by Rev. Dr. Barry, ed. ii, p. 285 (1808). See "Journ. Bot.," No. xiii, January 1864, p. 14; Bennett, "Suppl. Top. Bot.," p. 47 (1905); and Spence, "Flora Orcadensis," p. 41 (1914).

HIERACIUM RUBICUNDUM, *F. J. Hanbury, var. b.* BOSWELLI (*Linton*) in "Journ. Bot.," vol. xxxi, June 1893, pp. 178 and 179 (as a species) (*fide* E. F. Linton, 30th October 1914. See "CORRECTIONS").—Crags on hillside. 430 feet above sea-level, Dwarfie Hamars, Hoy, 22nd July 1912, H. H. Johnston. Native. On 20th September 1912 the same specimens were doubtfully identified as H. SILVATICUM, *Gouan, var. c.*, TRICOLOR, *W. R. Linton*, or *var. e.* ASYMMETRICUM, Ley, by the Rev. E. F. Linton, and they were recorded by me as *var. c.* TRICOLOR, *W. R. Linton*, in "Trans. Bot. Soc. Edin.," vol. xxvi, p. 211 (1914); and in Spence, "Flora Orcadensis," p. 131 (1914). With reference to these specimens, the Rev. E. F. Linton furnished me with the following written note, dated 30th October 1914, viz.:—"Not var. *tricolor*. May be var. *asymmetricum*, Ley, but has very hairy leaves for that. It has much the resemblance of my *H. rubicundum*, var.

Boswelli, which the hairs and ciliation suit better, but you reported yellow style. I am much inclined to place it with the last named." At the time I collected my specimens, on 22nd July 1912, I recorded the colour of the style and its branches as "yellow," but on examining the *dried* specimens in my herbarium, I find that the specimens are yellowish-brown, whereas the corollas remain bright yellow. In "An Account of the British Hieracia," by Rev. W. R. Linton, p. 25 (1905), the colour of the styles of H. RUBICUNDUM, *F. J. Hanbury*, is recorded as "yellowish or light olive"; but in the case of all my specimens of the type of that species, collected in the three islands of Hoy, Mainland, and Rousay, and also in the case of the *var. b.* BOSWELLI (*Linton*), collected at the Dwarfie Hamars, Hoy, the styles and their two branches were recorded by me as "yellow" in the living plants, and they have all turned yellowish-brown during the drying of the specimens, whereas the colour of the corollas still remain bright yellow in the dried specimens. If the name *var. b.* BOSWELLI (*Linton*) is correct, my record confirms that for this variety from Orkney in "An Account of the British Hieracia," by Rev. W. R. Linton, p. 25 (1905). My specimens were collected at the same stations as those (rather poor specimens) collected by the late Rev. W. R. Linton, at the Dwarfie Hamars, Hoy, on 10th August 1886, and which his brother, the Rev. E. F. Linton, thinks may be the *var. b.* BOSWELLI (*Linton*). See my "Note" on H. RUBICUNDUM, *F. J. Hanbury*, in "Trans. Bot. Soc. Edin.," vol. xxvi, p. 210 (1914); and "Annals Scot. Nat. Hist.," No. 58, April 1906, p. 95.

HIERACIUM RIVALE, *F. J. Hanbury, var. b.* DASYTHRIX, *Linton* in "Journ. Bot.," vol. xxxi, June 1893, p. 178 [= H. PICTORUM, *Linton, var.* DASYTHRIX, *Linton*] (*fide* E. F. Linton).—Crags in a glen, 280 feet above sea-level, Berriedale, Hoy, 7th September 1914, H. H. Johnston. Native. Style and its two branches yellowish-brown. A new record for this variety for H. C. Watson's county No. 111 Orkney.

HIERACIUM SARCOPHYLLUM, *Stenstr., var. c.* EXPALLIDIFORME, *Dahlst.* in "Stenstr. Värn. Archier.," 18 (1889), as a species; "Bidr. t. Syd. Sver. Hier.," ii, 174 (1893), as a

variety (*fide* E. F. Linton).—Crags on hillside, 750 feet above sea-level, south side of the Meadow of the Kame, Hoy, 11th September 1914, H. H. Johnston. Native. Style and its two branches yellowish-brown. Confirms the record of this variety from Hoy, Orkney, in "An Account of the British Hieracia," by Rev. W. R. Linton, p. 55 (1905). See also "Annals Scot. Nat. Hist.," No. 58, April 1906, p. 97; and "Trans. Bot. Soc. Edin.," vol. xxvii, p. 55 (1916).

Carduus arvensis, Curt. var. b. *setosus* (Bess.) (*fide* Arthur Bennett).—Gravelly ground round filter beds, 260 feet above sea-level, Kirkwall Waterworks Reservoir, near Hatston, Saint Ola, Mainland, 31st August 1916, H. H. Johnston. Not native. Rare. Corolla purple. See "The Student's Flora of the British Islands," by Sir J. D. Hooker, ed. i, p. 192 (1870); "Scot. Nat.," No. xlviii, October 1882, p. 367; Spence, "Flora Orcadensis," p. 39 (1914); and "Trans. Bot. Soc. Edin.," vol. xxvii, p. 56 (1916).

Senecio jacobaea, *Linn., var. b.* discoideus, *Linn.* [=*var. b.* flosculosus (*Jord.*)] (*fide* Arthur Bennett).—Natural shell-sandy pasture, 30 feet above sea-level, Links of Booth, Newark Bay, Deerness, Mainland, 19th August 1916, H. H. Johnston. Native. This variety, without ray florets, is much less common than the type of the species, with large and small ray florets on different plants, growing at the same station, and of which latter I also have specimens in my herbarium, collected by me at the same station and on the same date.

Gentiana campestris, *Linn., subsp.* baltica, *Murbeck* (*fide* Arthur Bennett).—Pasture near the seashore, 20 feet above sea-level, Swona, 28th July 1914, H. H. Johnston, calyx lobes 4, 2 large and 2 small, corolla purple; and short natural pasture near edge of sea-cliffs, 180 feet above sea-level, Black Craig, Stromness, Mainland, 4th August and 5th September 1919, H. H. Johnston, corolla dark purple. Native and common at both stations. See "Trans. Bot. Soc. Edin.," vol. xxvi, p. 221 (1914); and Spence, "Flora Orcadensis," pp. 49 and 132 (1914).

Convolvulus arvensis, Linn.—Gravelly ground round filter beds, 260 feet above sea-level, Kirkwall Waterworks

Reservoir, near Hatston, Saint Ola, Mainland, 31st August 1916, H. H. Johnston. Not native. Rare. Corolla pink. Confirms the record of this species from Orkney in Neill, "Tour," p. 185 (1806). See "Journ. Bot.," No. xiii, January 1864, p. 15; and Spence, "Flora Orcadensis," p. 50 (1914).

Euphrasia occidentalis, *Wettst.* (*fide* Cedric Bucknall). —Pasture at seashore, 5 feet above sea-level, Swona, 28th July 1914, H. H. Johnston. Native. Common. Cauline leaves 2–8 toothed. Corolla light purple, with darker purple lines, and a yellow spot on throat of lower lip. The same specimens were seen by the late Rev. E. S. Marshall, who wrote the following note on them, on 3rd September 1914, viz.:—"Forms of *E. curta*, I think, with large flowers. Some are hairy enough for type; others come nearer to var. *glabrescens*." But, on 18th October 1919, Mr. C. Bucknall wrote: "Not *Euphrasia curta*, as the leaves and bracts are very glandular.' This species and E. borealis, *Townsend* (*fide* C. Bucknall) both grow at the same station in Swona, and I have specimens of both, collected by me on the same date, in my herbarium.

Euphrasia latifolia, *Pursh* (*fide* C. Bucknall).— Natural heathery and grassy pasture, 90 feet above sea-level, Black Craig, Stromness, Mainland, 4th August and 5th September 1919, H. H. Johnston. Native. Common. Cauline leaves 2–6-toothed. Corolla pale lilac, with dark purple lines, and a yellow spot on throat of lower lip. A large number of living and dried specimens of this species were sent by me to Mr. Cedric Bucknall, who sent me the following written note, dated 18th October 1919, viz.:— "*Euphrasia latifolia*, Pursh. These specimens agree with Wettstein's description in bearing a few stipitate glands on the leaves and bracts. Having been gathered rather late in the season, they lack the large stem leaves with broad, obtuse terminal lobe which is so characteristic of *E. latifolia*, and being glandular they might easily be taken for *E. occidentalis*. This actually happened to a sheet of specimens from the same locality in Herb. Druce, gathered in 1912, which were variously named *E. curta*, *E. borealis*, and *E. occidentalis*. I have no doubt that

"Trans. Bot. Soc. Edin.," vol. xxix, part ii, p. 153 (1925).

In "Trans. Bot. Soc. Edin." vol. xxviii., part i., p. 34, lines 19-22 from top of page (1920), *delete from* "This species" *to the end of the paragraph* "my herbarium."

these were the same as the present 1919 gathering, and I have no hesitation in naming them all *E. latifolia.*" In the case of the specimens of EUPHRASIA collected by me at the Black Craig, Stromness, Mainland, on 19th August 1912, and distributed that year through the Botanical Exchange Club of the British Isles, the name EUPHRASIA LATIFOLIA, *Pursh* (*fide* C. Bucknall), should, therefore, be substituted for the following ones, viz.: (1) "*Euphrasia curta*, Wettst. (*fide* E. S. Marshall)," in "Bot. Exch. Club Distributor's Report for 1912," p. 273 (1913); (2) "*Euphrasia borealis*, Townsend (*fide* E. S. Marshall)," in "Bot. Exch. Club Distributor's Report for 1913," p. 516 (1914), "Trans. Bot. Soc. Edin.," vol. xxvi, p. 213 (1914), and Spence, "Flora Orcadensis," p. 133 (1914); and (3) "*Euphrasia occidentalis*, Wettst.," in "Bot. Exch. Club Secretary's Report for 1916," p. 497 (1917). See Messrs. W. H. Pearsall and D. Lumb's remarks in "Bot. Exch. Club Distributor's Report for 1916," p. 598 (1917), in which they state, with reference to my specimens collected at the Black Craig, Stromness, Mainland, on 19th August 1912, that "assisted by Mr Pugsley, we have come to the conclusion that *latifolia* is the more nearly correct name." My record of E. LATIFOLIA, *Pursh*, from the Black Craig, confirms that of the late Rev. E. S. Marshall for the same station, in "Journ. Bot.," vol. xxxix, August 1901, p. 270. See "Trans. Bot. Soc. Edin.," vol. xxvii, p. 56 (1916).

SCROPHULARIA NODOSA, *Linn.* (name confirmed by Arthur Bennett).—Heathery and ferny banks on north side of a glen, 350 feet above sea-level, Hoy, 19th and 27th June and 9th September 1914, H. H. Johnston. Native. Very rare. This species is, no doubt, the plant erroneously recorded as "SCROPHULARIA *Aquatica.* In Hoy, on banks of rills," in "History of the Orkney Islands," by Rev. Dr. Barry, ed. ii, p. 283 (1808). *S. aquatica*, Linn., grows in England and the south of Scotland, but it is included among the "OMITTED SPECIES" in H. C. Watson's "Florula Orcadensis," published in "Journ. Bot.," No. xiii, January 1864, pp. 11–20. S. NODOSA, *Linn.*, was recorded from the "Burn of Redland, Firth, and Burn above Church of Firth," Mainland, by the late Dr. A. R. Duguid, prior to 1858, but it has not been found at either of these two stations by

me or the late Mr. Magnus Spence. See "Scot. Nat.," No. xlviii, October 1882, p. 372; Spence, "Flora Orcadensis," p. 50 (1914); and "Trans. Bot. Soc. Edin.," vol. xxvii, p. 56 (1916).

* Mentha viridis, *Linn.* [=M. spicata, *Linn.*] (*fide* Arthur Bennett).—Wet, gravelly, and stony burnside, 90 feet above sea-level, Breibuster Burn, Hoy, 8th September 1914, H. H. Johnston. Naturalised. Very rare. Plants neither in flower nor in fruit. Mrs. Georgina Manson, Murra, Hoy, informed me, on 8th September 1914, that, about the year 1874, she saw the Spearmint growing in the *kail-yard* (cabbage garden) at Slack, higher up the side of Breibuster Burn from the place where this plant now grows. This plant therefore appears to have escaped from cultivation and become naturalised at the burnside below the farmhouse of Slack.

* Mentha piperita, *Linn., var. a.* officinalis (*Huds.*) (*fide* Arthur Bennett).—Swamp, 60 feet above sea-level, Little Ocklester, below and north-east of Newhouse, Holm, Mainland, 26th August 1916, H. H. Johnston. Naturalised. Rare. Plants in flower-bud only, and the fresh leaves have the characteristic odour of Peppermint. On the same date, and in the same neighbourhood, I saw a large clump of plants of the same species, in flower-bud, growing in a swamp, 80 feet above sea-level, below and north-east of Thistlequoy, Holm, Mainland; and I also saw it growing at the side of a ditch in the corn stack-yard of the farm of Thistlequoy, where, Mr. James Sutherland, Thistlequoy, informed me, on 26th August 1916, it has grown for many years past. The Peppermint does not occur in the garden at Newhouse. My record of this species from Little Ocklester confirms that of the late Mr. Magnus Spence from the same station, in his "Flora Orcadensis," p. 54 (1914); but, in my opinion, the Peppermint, which is cultivated in gardens in Orkney, has escaped from cultivation and become naturalised at Little Ocklester and Thistlequoy, both in the parish of Holm, Mainland.

Thymus Serpyllum, *Linn., var. b.* prostratus, Hornem (*fide* Arthur Bennett).—Bare stony hill-top, 400 feet above sea-level, small conical hill north of Sandy Loch, Hoy. 23rd June 1914, H. H. Johnston, plants in flower, with

procumbent rooting stems, and leaves with bristly margins; and grassy cliffs at seashore, 10 feet above sea-level, Head of Holland, Saint Ola, Mainland, 2nd September 1916, H. H. Johnston, plants mostly in unripe fruit, a few in flower, with the upper surface of the leaves and persistent calyx of the unripe fruits densely clothed with long white hairs. Native and common at both stations. My record confirms that of the late Rev. E. S. Marshall for this variety from Orkney (Sandwick, Mainland), in "Journ. Bot.," vol. xxxix, August 1901, p. 270. See also "Annals Scot. Nat. Hist.," No. 59, July 1906, p. 177; and Spence, "Flora Orcadensis," p. 54 (1914), where he states that he thinks he has never seen THYMUS SERPYLLUM, *Linn.*, in the East Mainland, but the Head of Holland is in it.

Nepeta hederacea, Trev. [=*N. Glechoma*, Benth.] (name confirmed by Arthur Bennett).—Artificial pasture in a garden, 80 feet above sea-level, Hall of Clestrain, Orphir, Mainland, 14th June 1919, H. H. Johnston. Not native. A garden weed. Rare. Corolla bluish-purple. Confirms the record of this species from Orkney by Mr. Patrick Neill in his "Tour," p. 187 (1806). See "Glechoma hederacea" in "Journ. Bot.," No. xiii, January 1864, p. 15; and Spence, "Flora Orcadensis," p. 54 (1914).

*Myosotis palustris, *With.* [=M. scorpioides, *Linn.*] (*fide* Arthur Bennett).—Marshy burnside, 20 feet above sea-level, Skaill Burn, Sandwick, Mainland, 25th July 1919, H. H. Johnston. Naturalised and common at Skaill Burn *below* a small garden, in which this species grows and from which it has escaped, at the bridge where the approach road to Skaill House crosses the burn. *Above* the garden, between the bridge and the loch of Skaill, I saw no plants of this species growing along the burnside; but it is common below the garden, between the bridge and the sea at Skaill Bay. Myosotis palustris, *With.*, is included among the "OMITTED SPECIES" in H. C. Watson's "Florula Orcadensis," published in "Journ. Bot.," No. xiii, January 1864, pp. 11–20. MYOSOTIS PALUSTRIS, *With., var. b.* STRIGULOSA (*Reichb.*) is recorded from Orkney (Scapa, Saint Ola, Mainland) by the late Dr. J. T. I. B. Boswell, but not the type of the species (which is cultivated in gardens in Orkney), in Watson, "Top. Bot.," ed. ii, p. 323

(1883). See "Scot. Nat.," No. xlviii, October 1882, p. 374; and Spence, "Flora Orcadensis," p. 58 (1914).

Symphytum peregrinum, Ledeb. (*fide* G. C. Druce).—Grassy ditch sides between two cultivated fields, 50 feet above sea-level, Orgill, Hoy, 16th June 1914, H. H. Johnston. Not native. Introduced by the late Mr. J. G. Moodie Heddle sometime between 1880 and 1890. Common at the corner of one field along a narrow strip fifty yards long, and still growing there on 11th May 1920. This species is recorded from Hoy and Bu, Burray, under the erroneous name of "S. OFFICINALE (Linn.), var. *patens* (Sibth.)," in Spence, "Flora Orcadensis," p. 57 (1914).

UTRICULARIA NEGLECTA, *Lehm.* [=U. MAJOR, *Schmidel*] (*fide* Arthur Bennett).—Mud at bottom of shallow water in a loch, 8 feet above sea-level, Loch of Græmeshall, Holm, Mainland, 25th August 1916, H. H. Johnston. Native. Common among the stems of SCIRPUS TABERNAEMONTANI, *Gmel.*, at the west side of the loch. Luxuriant plants neither in flower nor fruit. A new record for this species for H. C. Watson's county No. 111 Orkney. See "Bot. Exchange Club Secretary's Report for 1916," p. 497 (1917).

SALIX REPENS, *Linn., var. e.* PARVIFOLIA (*Sm.*) ♀ (*fide* E. F. Linton).—Heath, 50 feet above sea-level, Swona, 28th July 1914, H. H. Johnston. Native. Common. Confirms the record of this variety from Orkney ("Westray, 1905"), in Spence, "Flora Orcadensis," p. 67 (1914),

CLASS II.—MONOCOTYLEDONS.

SPARGANIUM AFFINE, *Schnizl., var. b.* MICROCEPHALUM, *Neum.* (*fide* Arthur Bennett).—Mud at bottom of water in a large pool, 80 feet above sea-level, at the junction of Roonie Gill Burn with South Burn, Hoy, 4th September 1914, H. H. Johnston. Native. Common in the pool. Plants in flower and unripe fruit, but mostly the latter. Confirms the record for this variety from Orkney in "The Scottish Botanical Review," vol. i, p. 94 (1912): but my specimens were collected at a different part of Hoy from those collected by the late Rev. E. S. Marshall "in a pool near Sandy Loch, towards Orgill," in July 1900, and

recorded by him as "*S. affine*, Schnizl.," in "Journ. Bot.," vol. xxxix, August 1901, p. 273. See Spence, "Flora Orcadensis," pp. 69 and 70 (1914).

ORCHIS MACULATA, *Linn.*, *subsp.* ERICETORUM, *Linton* in "Flora of Bournemouth," by Rev. E. F. Linton, p. 208 (1902).—Damp pasture, Midland Hill, Orphir, Mainland, 29th July 1876, H. H. Johnston; hillside and hilly pasture, Hoy, 24th and 25th July 1877, respectively, H. H. Johnston; and heath, 220 feet above sea-level, South Dam, Hoy, 22nd June and 3rd September 1914, H. H. Johnston (name confirmed by E. F. Linton). Native and common at all these stations. This subspecies is the commonest and most widely distributed ORCHIS in Orkney, and it is the only form of O. MACULATA, *Linn.*, that I have found in H. C. Watson's county No. 111 Orkney. My specimens, collected in 1876 and 1877, were identified as "O. MACULATA, *Linn.*," by the late Dr. J. T. I. B. Boswell, but he doubtfully referred my specimen collected on 25th July 1877 to this species. In the opinion of Dr. G. Claridge Druce, the *subsp.* ERICETORUM, *Linton*, is the true type of ORCHIS MACULATA, *Linn.*, "Species Plantarum." See "Bot. Exch. Club Secretary's Report for 1914," pp. 99–105 (1915); and *ibid.* for 1917, p. 165 (1918). The following notes were made by me from living plants at South Dam, Hoy, on 22nd June 1914, viz.:—Stem *solid*. Leaves spotted dark purple. Flowers faintly scented. Perianth *pale lilac*, with dark crimson-purple streaks and spots on the two lateral sepals and lip; two lateral sepals *patent*; middle sepal and two petals connivent; lip *flat*, 3-lobed, with the middle lobe *shorter* and *narrower* than the two lateral lobes, and *recurved*. Three of the plants I found in Hoy, on 24th July 1877, had *white* flowers, but *pale lilac* is the usual colour of the flowers in this ORCHIS in Orkney.

JUNCUS BUFONIUS, *Linn.*, *var. b.* FASCICULATUS (*Bert.*) (name confirmed by Arthur Bennett, who remarks, "I think so, but a poor state of it").—Muddy and gravelly foreshore of a brackish water loch, 5 feet above sea-level, Ayre Loch, Copinsay, 22nd August 1916, H. H. Johnston. Native. Common. Plants in unripe fruit. A new record for this variety for H. C. Watson's county No. 111 Orkney.

Scirpus Tabernaemontani, *Gmel.* [=S. glaucus, *Sm.*] (name confirmed by Arthur Bennett).—Mud at bottom of shallow water at margin of loch, 8 feet above sea-level, Loch of Græmeshall, Holm, Mainland, 25th August 1916, H. H. Johnston. Native. Common in loch. Plants in flower. Stems 3–5 feet high. Flowers proterogynous, the mature anthers being exserted from the glumes after the stigmas have withered in the *same* flowers. Stigmas 2. Confirms Dr. Gillies's record of this species from Orkney in "Journ. Bot.," No. xiii, January 1864, p. 16, and the late Mr. Magnus Spence's record of it from the Loch of Græmeshall, in his "Flora Orcadensis," p. 81 (1914); and removes "[111; errors?]," from the "supposed errors" in Watson, "Top. Bot.," ed. ii, p. 440 (1883). See "Scot. Nat.," No. ii, new series, October 1883, p. 73.

Carex paniculata, *Linn.*, *form.* simplicior, *Anders.* (1846) [=*var. b.* simplex, *Gray*, "Nat. Arr. Brit. Pl.," p. 46 (1821)] (*fide* Arthur Bennett), growing together with the type of the species C. paniculata, *Linn.* (name confirmed by Arthur Bennett), in a marsh, 130 feet above sea-level, Dee of Durkadale, Birsay, Mainland, 25th July 1919, H. H. Johnston. Native. Rare. Stem triangular with *flat* sides in the *form* simplicior, *Anders.*, and triangular with one side *flat* and the other two sides *slightly convex* in the type of the species, and in both the form and type the leaves are green and channelled. This form or variety of C. paniculata, *Linn.*, is a new record for H. C. Watson's county No. 111 Orkney. Mr. John Spence, Overabist, Birsay, showed me the station at the Dee of Durkadale for these two plants.

Carex vulgaris, *Fries*, *var. c.* melaena (*Wimm.*) [=C. Goodenowii, *Gay*, *var. c.* melaena (*Wimm.*] (*fide* Arthur Bennett, who writes, "Apparently the variety *melaena*").—Wet burnside, 240 feet above sea-level, Sowa Dee, Stromness, Mainland, 15th July 1913, H. H. Johnston. Native A new record for this variety for H. C. Watson's county No. 111 Orkney.

Carex rigida, *Good.* (*fide* Arthur Bennett).—Hillside, three-fourths way up in a greenish stripe, north-east side of Ward Hill, Hoy, 18th August 1881, W. A. Irvine Fortescue. Native. Confirms Robert Heddle's record of

this species from the Ward Hill, Hoy, in "Scot. Nat.," No. ii, new series, October 1883, p. 73. See Spence, "Flora Orcadensis," p. 83 (1914).

CAREX OEDERI, *Retz., var. e.* PYGMAEA, *Anders.*, in "Cyperaceae Scand.," p. 25 (1849) (*fide* Arthur Bennett).—Short wet natural pasture, 100 feet above sea-level, between Valley Burn and Glen of Button, Hoy, 19th June and 9th September 1914, H. H. Johnston, Native. Rare. Stigmas 3. A new record for this variety for H. C. Watson's county No. 111 Orkney. In a written note, dated 18th November 1914, Mr. Arthur Bennett writes, "I think I have seen *β pygmaea* from Caithness and Sutherland, whether *inland or not* I cannot say." This variety is not mentioned in "The London Catalogue of British Plants," tenth edition (1908).

CAREX BINERVIS, *Sm. var. b.* ALPINA, *Drejer* in "Crit. Rev. Car." (1841) [=*var. b.* SADLERI (*Linton*) of "Lond. Cat.," ed. x (1908)] (*fide* Arthur Bennett).—Heathery hill-top, 330 feet above sea-level, summit of Kirbuster Hill, Birsay, Mainland, 15th September 1919, H. H. Johnston. Native. Common. A new record for this variety for H. C. Watson's county No. 111 Orkney.

CAREX LIMOSA, *Linn.* (name confirmed by Arthur Bennett, who in a note writes, "All good typical *limosa*").—Swamp, 400 feet above sea-level, Meadow of Surtoo ("Bog of Surtan" in 1-inch Ordnance Map published in 1912), at source of Burn of Kit Huntlins, Birsay, Mainland, 25th July 1919, H. H. Johnston; and swamp, 130 feet above sea-level, Dee of Durkadale, Birsay, Mainland, 15th September 1919, H. H. Johnston. Native and common at both stations. Confirms Mr. G. W. Scarth's record of this species from the Meadow of Surtoo in 1918, in Spence, "Flora Orcadensis," p. 84 (1914). Mr. John Spence, Overabist, Birsay, showed me both stations for this species. This species is not recorded from County No. 111 Orkney in Watson, "Top. Bot.," ed. ii (1883), nor in Bennett, "Suppl. Top. Bot." (1905).

POA PRATENSIS, *Linn., var. b.* SUBCOERULEA (*Smith*) (*fide* Arthur Bennett).—Heap of earth and stones from a stone quarry, 360 feet above sea-level, Hill of Heddle, Firth, Mainland, 15th July 1919, H. H. Johnston. Native.

Common. A new record for this variety for H. C. Watson's county No. 111 Orkney.

Festuca ovina, *Linn., var. b.* tenuifolia (*Sibth.*, as a species, 1794) [=*var. b.* capillata, *Hackel* (1882)] (*fide* Arthur Bennett).—Marshy burnside, 150 feet above sea-level, Lunan, Harray, Mainland, 1st July 1919. Native. Common. Plants in full flower. A new record for this variety for H. C. Watson's county No. 111 Orkney.

Class III.—Cryptogams.

Asplenium Ruta-muraria, *Linn.* (name confirmed by Arthur Bennett).—Clefts of rocks on hillside. 480 feet above sea-level, Rousay, 30th August 1916, H. H. Johnston. Native. Rare. This species is, no doubt, the plant erroneously recorded from Orkney as "Acrostichum *Septentrionale*. Clefts of rocks," in "History of the Orkney Islands," by Rev. Dr. Barry, ed. ii, p. 288 (1808), and which latter species, under the name of "Asplenium septentrionale," is included among the "Omitted Species" in H. C. Watson's "Florula Orcadensis," published in "Journ. Bot.," No. xiii, January 1864, pp. 11–20. My record of A. Ruta-muraria, *Linn.*, from Rousay, confirms the record of this species from Orkney in "Journ. Bot.," No. xiii, January 1864, p. 17. See "Scot. Nat.," No. iii, new series, January 1884, p. 112; and Spence, "Flora Orcadensis," p. 93 (1914).

Equisetum palustre, *Linn., var. c.* nudum, *Newman* in "Phytologist," vol. i. p. 627 (1843) [=*var. b.* subnudum of "Lond. Cat.," ed. vii, (1874)] (*fide* Arthur Bennett and E. S. Marshall).—Marsh at side of mill-pond, 250 feet above sea-level, North Dam, Orgill, Hoy, 27th June 1914. H. H. Johnston. Native. Confirms the late Rev. E. S. Marshall's record of this variety from the same station, in "Journ. Bot." vol. xxxix, August 1901, p. 275. See "Annals Scot. Nat. Hist.," No. 64, October 1907, p. 230; and "Trans. Bot. Soc. Edin.," vol. xxvii, p. 58 (1916).

OBSERVATIONS ON "NOTES ON THE FLORA OF THE ORKNEY ISLES. By Arthur Bennett, A.L.S.," published in "Transactions of the Botanical Society of Edinburgh," vol. xxvii, part i, pp. 54–59 (1916). By Colonel H. H. JOHNSTON, C.B., C.B.E., D.Sc., F.R.S.E., F.L.S.

[(Read 10th June 1920.)

Under "*Lupinus nootkatensis*, Donn.," and "*Primula scotica*, Hook.," *for* "Trail" *read* Traill. (The late Dr. William Traill of Woodwick, Orkney.)

Under "*Alchemilla alpestris*, Schmidt," "*Sedum acre*, Linn.," and "*Arctium minus*, Bernh.," the late Mr. A. Somerville should have recorded the name of the station for these plants as Sanday, and not "Sandy Island," which latter is an English translation of the Norse name Sand-ey (now spelled Sanday).

On page 55, line 10 from bottom of page, after "Koch" complete the inverted commas thus:—Koch"; and in line 8 from bottom of same page *delete* the inverted commas *after* "practice."

With reference to "*Hiercium strictum*, Fr.—Hobbister rocks, Orphir, Syme," specimens of a *Hieracium* collected by me and Miss I. B. I. Fortescue, at Hobbister, Orphir, Mainland, on 11th August 1880, were so named by the late Dr. J. T. I. B. Boswell (formerly Mr. John T. Syme), who sent Miss Fortescue's specimens to the Botanical Exchange Club under that name; but my herbarium specimen has since been identified as *Hieracium corymbosum*, Fries, var. *salicifolium* (Lindeb.), by Mr. F. J. Hanbury, and recorded by me under this name in "The Annals of Scottish Natural History," July 1895, p. 178. *H. strictum*, Fries, therefore, does not appear to grow in Orkney. See "Botanical Exchange Club Report for 1880," p. 33 (1881).

Under "*Pimpinella Saxifraga*, Linn.," *delete* "Heathy hillside, 320 feet alt. Hoy, 1912. H. H. Johnston," but *add* the same remarks under "*Pyrola rotundifolia*, Linn."

With reference to "*Euphrasia nemorosa*, Mart.—Moul Head, Deerness, 1884. W. I. Fortescue sp.," specimens of this gathering were sent to the Botanical Exchange Club

in 1885, and in the "Botanical Exchange Club Report for 1885," p. 133 (1886), the late Mr. F. Townsend remarks, "Stunted form of *E. nemorosa*." This name is probably an error of identification, because, with reference to other specimens of *Euphrasia* collected by me at Skaill, Sandwick, Mainland, on 19th August 1881, and by me and Mr. W. I. Fortescue at Linksness, Hoy, on 20th August 1885, on all of which the late Mr. F. Townsend remarked, "Robust coast form of *E. nemerosa*, H. Mart.; flowers unusually large," the late Rev. E. S. Marshall wrote as follows, on 16th October 1913:—"These are all, I believe, *E. borealis*, Townsend, certainly not *E. nemerosa*. At that time I do not think that Mr. Townsend had yet described *borealis*." I have asked Dr. W. A. Irvine Fortescue to send me specimens of his Moul Head *Euphrasia*, and, if received, I shall send them to Mr. Cedric Bucknall for identification.

Rumex conspersus, Hartm., is recorded for county No. 111 Orkney, on Dr. J. T. I. B. Boswell's authority, in H. C. Watson's "Topographical Botany," ed. ii, p. 358 (1883); but in Dr. Boswell's manuscript catalogue of plants seen by him in Orkney (copied by me on 11th January 1881), he has entered a "?" after both the name of this species and after the name of the station for it at "Scapa," together with the following note:—"B. saw a plant at Scapa excessively like this, but can't be quite sure." ("B." stands for Boswell.) Dr. Boswell paid his last visit to Orkney in 1880, so that his record for this species in Orkney is still doubtful, and requires confirmation.

On page 57, line 1 at top of page, *for* "var. *granulatus*" *read* var. *trigranulatus*.

With reference to "*Betula glutinosa*, Fr.—Orkney. Syme in Top. Bot., 372," there is only one kind of native Birch in Orkney, and the following synonyms all refer to the same plant, viz.:—*Betula alba*, Linn., var. b. *glutinosa*, of "The London Catalogue of British Plants," ed. vii (1874): *B. glutinosa*, Fr., ibid., ed. viii (1886); *B. pubescens*, Ehrh., ibid., ed. ix (1895); *B. tomentosa*, Reith. et Abel, ibid., ed. x (1908); and *B. alba*, Linn., of Babington's "Manual of British Botany," ed. ix, p. 388 (1904), under which last name the Orkney Birch is recorded in Magnus Spence's "Flora Orcadensis," p. 65 (1914).

Under "*Ceratophyllum demersum*," *for* "Loch of Ayre, Kirbister," *read* Loch of Ayre, Holm. See "The Scottish Naturalist," No. 1, New Series, July 1883, p. 22, where Mr. W. Irvine Fortescue has recorded the late Mr. Robert Heddle's two stations for this species as "Loch of Ayre, Hubbin at Kirbuster." The former station is in the parish of Holm, and the latter one in the parish of Orphir, both in Mainland and seven miles apart.

With reference to "*Zannichellia palustris*, Linn.—Kirbister Loch, 1850, Syme," this species is recorded from that station by Mr. John T. Syme (afterwards Dr. J. T. I. B. Boswell) in "Trans. Bot. Soc. Edin.," vol. iv, part i, p. 48 (1850); but, on 31st December 1878, the late Dr. Boswell informed me that the above-mentioned name was an error, and that the correct name of the plant he found in the Loch of Kirbister is *Z. polycarpa*, Nolte, var. b. *tenuissima*, Fries. *Z. palustris*, Linn., has never been seen in Orkney by Dr. Boswell, and "111 Orkney, Syme sp.," under this species, should, therefore, be omitted from H. C. Watson's "Topographical Botany," ed. ii, p. 424 (1883). The "Syme sp." probably refers to the specimens collected by Mr. Syme in 1849, and at that time erroneously labelled by him as "*Zannichellia palustris*, Linn.," as already explained above.

Luzula pilosa, Willd, has never been seen in Orkney by Dr. Boswell, Dr. Fortescue, Mr. Magnus Spence, nor by me, although I have specially looked for it during the present year in Mainland and Hoy, where *L. sylvatica*, Gaud., is common in many different localities. Mr. Patrick Neill, in his "Tour through Orkney and Shetland," in 1804, p. 186 (1806), records this species under the name of "*Juncus pilosus*, Hairy Rush," from Rousay.

Under "*Festuca bromoides*, Linn.," *for* "Skail" *read* Skaill.

Equisetum palustre, Linn., var. *nudum*, Newm., was recorded from Orgill, Hoy, by the late Rev. E. S. Marshall, in "Journ. Bot.," vol. xxxix, August 1901, p. 275.

Under "*Ophioglossum vulgatum*, Linn., var. *ambiguum*, Coss. et. Germ.," *for* "Miss P. Deuche" *read* Miss P. Deuchar.

Delete the "*" before "*Chara fragilis*, Desv. var. *capil-*

lacea, Coss. et Germ." This variety is recorded in Spence's "Flora Orcadensis," p. 136 (1914).

On page 59, line 13 from top of page, *for* "Rev. J. Hendrick" *read* Rev. J. Headrick.

Corrections to "Notice of some of the Rarer Plants observed in Orkney during the Summer of 1849. By John T. Syme, Esq.," published in "Transactions of the Botanical Society of Edinburgh," vol. iv, part i, pp. 47–50 (1850). By Colonel H. H. Johnston, C.B., C.B.E., D.Sc., F.R.S.E., F.L.S.

(Read 10th June 1920.)

On 31st December 1878, the late Dr. J. T. I. B. Boswell (formerly Mr. John T. Syme) made the following corrections in my copy of the above-mentioned "Transactions," viz.:—

Page 48, line 10 from bottom of page, for "*Potamogeton filiformis*" read *Potamogeton pectinatus*, Linn.

Page 48, line 5 from bottom of page, for "*Zannichellia palustris*" read *Zannichellia polycarpa*, Nolte, var. b. *tenuissima*, Fries.

Page 49, line 2 from top of page, for "*Eleocharis uniglumis*" read *Eleocharis multicaulis*, Sm.

The following corrections should also be made. viz.:—

Pages 47, 48, and 50, *for* "mainland" *read* Mainland.

Pages 48–50, *for* "Robert Heddel" *read* Robert Heddle.

Pages 48 and 50, *for* "Howton Head" *read* Houton Head.

Page 48, line 11 from bottom of page, *for* "north-west" *read* north-east.

Pages 48 and 49, *for* "Neversdale" *read* Naversdale.

Page 49, *for* "Bow" *read* Bu.

Page 49, line 7 from bottom of page, *for* "north-west" *read* north-east.

Page 50, line 11 from top of page, *for* "north-west" *read* north-east.

A New Species of Phomopsis Parasitic on the Douglas Fir. By Malcolm Wilson, D.Sc., F.R.S.E., F.L.S.

(Read 10th June and 21st October 1920.)

Phomopsis Pseudotsugae, n. sp.

Pycnidia undique densiuscule distributa vulgo 2–3 mm. inter se distantia, obpyriformia, basi complanata, e cortice rupta paullo protrusa, opaco-nigrida, ·3–1 mm. diametro, ostiolo pertusa, intus plurilocellaria disseptis centralibus tenuibus atque cum muris obscure nigro-olivaceis; sporulae hyalinae, dimorphae; aliae (A-sporulae) elliptico-fusoideae, eguttulatae, utrinque obtusae $5{\cdot}5–8{\cdot}5 \times 2{\cdot}5–4\,\mu$, sporophoris subulatis circiter $13\,\mu$ longis; aliae (B-sporulae) in pycnidiis discretis orientes, bacillares, curvatae vel raro rectae, eguttulatae, utrinque obtusae, $5–6 \times 1{\cdot}5\,\mu$, sporophoris rectis, subulatis, $13 \times 1–2\,\mu$.

Hab. in ramis foliisque vivis *Pseudotsugae Douglasii* quam in Scotia multo vexat.

The fungus attacks the Douglas fir[1] in two distinct ways. In the first the leading shoot is killed back for a variable distance, usually about 9 inches. In the second the young tree is attacked a short distance above the ground level; the outer tissues are killed either on one side only or completely round the stem, and ultimately the whole tree is killed. In both cases a very characteristic feature of the disease is the sudden decrease in diameter in passing from the healthy to the diseased portion of the stem. The fungus has been found up to the present only on trees up to twelve years old.

The pycnidia are at first covered by the bark or epidermis of the leaf, and later on break through, in the case of those on the stems, by means of an elongated slit. Those containing A-spores are generally rather larger, are often found in groups of two, and occur on the older parts of the host, never on the leaves; only A-spores have been found on plants attacked near ground level. Pycnidia containing B-spores are usually rather smaller, more

[1] An account of the effect of the fungus on its host appears in the current number of the Transactions of the Royal Scottish Arboricultural Society.

decidedly conical, solitary, and have been found on both surfaces of the leaf, but usually on the upper surface and on the younger parts of the one-year-old stems.

The external wall of the pycnidium is everywhere several cells in thickness; these cells are more or less hyaline, and are tinged with green below, but are more opaque and darker in colour towards the upper part of the pycnidium where the wall is considerably thicker. The ostiolar passage is comparatively wide, and although the spores often emerge in the form of tendril-like masses, they frequently form rounded drops at the mouth of the pycnidium.

The A-spores vary considerably in shape and size. When a mature pycnidium (*i.e.* one from which the spores will exude naturally if kept sufficiently damp) is crushed most of the spores are found detached from the sporophores, and the latter form a distinct zone in contact with the wall of the pycnidium. Many of the sporophores appear to be partly disintegrated. The spores can be roughly divided into three groups, as follows:—(1) A few of small size ($5{\cdot}5 \times 2{\cdot}5\ \mu$), which stain readily, and are still attached to the sporophores; (2) a large number, free from the sporophores, which have attained their full length ($6{\cdot}5$–$8\ \mu$), but which are comparatively narrow ($2{\cdot}5\ \mu$ wide), and which still stain readily; (3) a considerable number, free from the sporophores, which are mature and have attained their full size ($6{\cdot}5$–$8{\cdot}5 \times 3$–$4\ \mu$), in which the wall is slightly thicker, and which do not stain readily. Spores which naturally exude from the pycnidium are similar to those of the third group: they are not accompanied by the sporophores, for these remain inside the pycnidium attached to its walls. The spores are without oil-drops, but often have a minute granule towards one or both ends.

The B-spores are unusually short compared to those of other species of *Phomopsis*,[1] but show the characteristic arrangement parallel to each other "in serried ranks" when they emerge from a crushed pycnidium. They are easily detached from the sporophores, which, as in the case of the A-spores, remain attached to the walls of the pycnidium.

[1] See Grove, The British Species of *Phomopsis*, Kew Bull., 1917, p. 49.

In both kinds of spores the sporophores can be clearly seen in the young pycnidium, but at maturity they become somewhat mucilaginous, and partially disintegrate.

Phomopsis Pseudotsugae differs from *Phoma abietina* Hartig, which has been stated by Böhm [1] to attack the Douglas fir, not only in the occurrence of the B-spores but also in the form and size of the A-spores. Examination of a specimen of *P. abietina* on *Abies pectinata* collected by Hartig shows that the spores of the species are nearly twice the size of those of *Phomopsis Pseudotsugae*; they are acute at the ends, rather irregular in form, and provided with two or more large oil-drops towards the ends, so that the protoplasm is almost confined to the central portion of the spore. *P. abietina* Hartig is synonymous with *Fusicoccum abietinum* Prill. et Delacr., and should now be placed in the genus *Phomopsis*. *Phoma pithya* Sacc. (*Sclerophoma pithya* Died.) has also been stated by Rostrup [2] to attack the Douglas fir, and this species is considered by Lind [3] to be the same as *Phoma abietina* Hartig. *Phomopsis Pseudotsugae* differs from *Phoma pithya* both in the structure of the pycnidium and in the absence of sporophores in the latter, which, as far as known at present, is only saprophytic.[4]

Specimens of *Phomopsis Pseudotsugae* have been obtained from various localities in Perthshire, from near Forres, and from Argyllshire, Dumfries, and Inverness, and the species appears to be widely distributed in Scotland.

[1] Zeitsch. f. Forst- u. Jagd-wesen, 1896, p. 154.
[2] Undersogelser over Snyltes vampes Angreb paa Skovtraer, 1883–1888.
[3] Danish Fungi, Copenhagen, 1913, p. 421.
[4] See Grove, New or Noteworthy Fungi, Pt. VI, Journ. Bot., vol. lvi, 1918, p. 293.

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

VOLUME XXVIII.

PART II.

SESSION 1920–21.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY BY
NEILL & CO., LIMITED.

And to be obtained from the SECRETARY OF THE SOCIETY, *at the Royal Botanic Garden.*

1921.

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TRANSACTIONS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXV

Additions to the Flora of Orkney, as recorded in Watson's "Topographical Botany," Second Edition (1883). By Colonel H. H. Johnston, C.B., C.B.E., D.Sc., F.R.S.E., F.L.S.

(Read 17th March 1921.)

This paper forms a continuation of three papers on the same subject, one of which I read before the Scottish Natural History Society on 4th April 1895, and which was published in "The Annals of Scottish Natural History," July 1895, and the other two before the Botanical Society of Edinburgh on 15th January 1914 and 10th June 1920, and which were published in the Society's "Transactions," vol. xxvi, pp. 207–217 (1914), and vol. xxviii, pp. 23–42 (1920), respectively. Most of the plants mentioned in this paper were collected by me during the year 1920.

Before and after the publication of the second edition of Watson's "Topographical Botany," in 1883, several of the plants mentioned in the following list have been recorded from Orkney by me and other botanists; but, as the value of botanical records is greatly enhanced by the possession of authentic specimens, I have included in this list the names of all specimens in my herbarium, which are either additional to or confirm doubtful records of the plants recorded from County No. 111 Orkney in the second edition of the above-mentioned book.

In the case of those plants which have already been recorded from Orkney, references are given in the following list, under each species and variety, to the books in which the records have been published. These records are principally contained in "A Tour through some of the Islands of Orkney and Shetland," in the year 1804, by Patrick Neill (1806); "Notice of some of the rarer Plants observed in Orkney during the Summer of 1849," by John T. Syme, Esq., published in the "Transactions of the Botanical Society of Edinburgh," vol. iv, pp. 47–50 (1850); "Florula Orcadensis—A list of plants reported to occur in the Orkney Isles," by H. C. Watson, Esq., F.L.S., published in the "Journal of Botany," No. xiii. pp. 11–20 (January 1864); Annual Reports of the Botanical Exchange Club of the British Isles; "A new List of the Flowering Plants and Ferns of Orkney," edited by W. A. Irvine Fortescue, and published in "The Scottish Naturalist" (1882–1884); "Supplement to Topographical Botany, ed. ii," by Arthur Bennett, A.L.S. (1905); and "Flora Orcadensis," by Magnus Spence, F.E.I.S. (1914).

The nomenclature followed is that of the second edition of Watson's "Topographical Botany" (1883), except in the case of species and varieties which are not recorded in that work. In the latter case the nomenclature adopted is that of "The London Catalogue of British Plants," tenth edition (1908). Non-native plants, which have become naturalised in Orkney, are distinguished by a * prefixed to the names, and the names of casuals are printed in italics.

Of the 49 species, varieties, and hybrids recorded from Orkney in the following list, 29 are native, 1 is naturalised, 18 are mere casuals introduced into Orkney through the agency of cultivation, and 1 was planted by man.

Abbreviations.

"Annals Scot. Nat. Hist." = The Annals of Scottish Natural History.

Bennett. "Suppl. Top. Bot." = Supplement to H. C. Watson's Topographical Botany, second edition. By Arthur Bennett, A.L.S. (1905).

"Bot. Exch. Club Report" (separate Reports by the Secretary and Distributor) = Report of The Botanical Exchange Club of the British Isles, at present called The Botanical Exchange Club and Society of the British Isles.

"Journ. Bot."=The Journal of Botany.
"Lond. Cat."=The London Catalogue of British Plants.
Neill, "Tour"=A Tour through some of the Islands of Orkney and Shetland, in the year 1804. By Patrick Neill, A.M., Secretary to the Natural History Society of Edinburgh (1806).
"Scot. Nat."=The Scottish Naturalist.
Spence, "Flora Orcadensis"=Flora Orcadensis. By Magnus Spence, F.E.I.S. (1914).
Watson, "Top. Bot."=Topographical Botany, second edition. By H. C. Watson (1883).

Corrections.

In "Annals Scot. Nat. Hist," July 1895, p. 177, *for* "Foeniculum vulgare, *Gaert.*," *read* *Carum Carvi, *Linn.*, and in the next line *for* "Native" *read* Naturalised.

In "Bot. Exch. Club Report for 1912," p. 273 (1913); "Trans. Bot. Soc. Edin.," vol. xxvi, p. 215 (1914); and Spence, "Flora Orcadensis," p. 134 (1914), *for* "Euphrasia curta, *Wettst.*, *var. b.* glabrescens, *Wettst.* (*fide* E. S. Marshall)," *read* Euphrasia caerulea, *Tausch* (*fide* Cedric Bucknall).

In "Trans. Bot. Soc. Edin.," vol. xxvi, p. 216 (1914), and Spence, "Flora Orcadensis," p. 136 (1914), *for* "Avena pratensis, *Linn.* (*fide* Arthur Bennett)," *read* Arrhenatherum elatius, *Mert. et Koch* [=Avena elatior, *Linn.*] (*fide* G. C. Druce and Arthur Bennett).

Class I.—Dicotyledons.

Aconitum Stroerckianum, Reichenb. (*fide* Otto Stapf).—Rubbish heap at seashore, 10 feet above sea-level, Hamla Voe, Stromness, Mainland, 16th July 1920, Henry Halcro Johnston. Not native. Four plants only seen by me, and these are now extinct, through the bank on which they grew having been washed away by the sea during a severe storm, accompanied by an exceptionally high tide, on 15th November 1920. Sepals pale whitish-blue, with dark purplish-blue margins. This species is cultivated in gardens in Stromness, from which it has probably been thrown out with weeds and rubbish.

Lepidium perfoliatum, Linn. (*fide* G. C. Druce).—Gravelly ground round filter beds, 200 feet above sea-level, Kirkwall Waterworks Reservoir, near Hatston,

Saint Ola. Mainland, 9th August 1920, H. H. Johnston. Not native. Very rare.

Barbarea intermedia, Boreau (*fide* T. A. Sprague).—Garden hedge, 15 feet above sea-level, Manse, Hoy, 11th June 1920. 31st July 1920, and 30th September 1920. H. H. Johnston. Not native. A garden weed. Very rare.

Nasturtium terrestre, *Sm.* [= *N. palustre*, *DC.*] —Marshy lochside, 10 feet above sea-level, Loch of Garsow, North Ronaldsay, 21st August 1920, H. H. Johnston; and marshy lochside, 10 feet above sea-level, Loch of Hooking, North Ronaldsay, 23rd August 1920, H. H. Johnston. Native and rare at both stations. Plants in full flower. Petals yellow. Confirms the record of this species from North Ronaldsay in "Annals Scot. Nat. Hist.," No. 69, p. 53 (January 1909), and in Spence, "Flora Orcadensis," p. 5 (1914), where it is recorded from Ancum Loch; but I failed to find it at that loch on 20th and 23rd August 1920, and Mr. John Scott, Northmanse, North Ronaldsay, informed me, on 20th August 1920, that it does not grow there.

Sinapis muralis, Br. [= *Diplotaxis muralis*, DC.] (*fide* G. C. Druce)—Flower border at the side of a house, 40 feet above sea-level, Finstown, Firth, Mainland, 9th August 1920 and 23rd September 1920, H. H. Johnston. Not native. A garden weed. Very rare.

Viola cornuta, Linn. (*fide* G. C. Druce).—Waste ground, 80 feet above sea-level, Finstown, Firth, Mainland, 29th July 1920, H. H. Johnston. Not native. Petals blue, with a pale yellowish-white spot on throat of lowest petal.

Sagina procumbens, *Linn., var. b.* spinosa, *Gibs.* (name confirmed by Arthur Bennett).—Road, 150 feet above sea-level, Grieveship, Stromness, Mainland, 17th August 1920, H. H. Johnston. Native. Rare. Plants in fruit. Leaves linear, awned, minutely spinose—ciliate on the margins. Peduncles and sepals glabrous. Confirms Dr. J. Grant's record for this variety from "near Stromness" in Spence, "Flora Orcadensis," p. 12 (1914).

Hypericum pulchrum, *Linn., var. b.* procumbens, *Rostrup* (*fide* Arthur Bennett).—Natural heathery and grassy pasture, 40 feet above sea-level, Purtabreck, North Ronaldsay, 20th August 1920, H. H. Johnston. Native.

Rare. See Spence, "Flora Orcadensis," p. xix (1914), with reference to an exposed heath near the Lighthouse at the north end of North Ronaldsay, where he states:—"St. John's wort, *Hypericum pulchrum*, was so prostrated by exposure to high winds that at first it looked like a new variety."

Geranium pratense, Linn. (*fide* Arthur Bennett).—Roadside, 50 feet above sea-level, near Holland House, North Ronaldsay, 24th August 1920. Not native. Very rare. Confirms the record of this species as an alien in Orkney, by the late Professor J. W. H. Trail, in "Annals Scot. Nat. Hist.," No. 56, p. 232 (October 1905). See Bennett, "Suppl. Top. Bot.," ed. ii, p. 25 (1905); and Spence, "Flora Orcadensis," p. 15 (1914).

Medicago falcata, Linn. (*fide* G. C. Druce).—Gravelly ground round filter beds, 200 feet above sea-level, Kirkwall Waterworks Reservoir, near Hatston, Saint Ola, Mainland, 9th August 1920, H. H. Johnston. Not native. Rare.

Vicia hirsuta, S. F. Gray.—Garden, 50 feet above sea-level, Scapa Distillery, Saint Ola, Mainland, 16th September 1920, H. H. Johnston. Not native. A weed of cultivation. One plant only seen by me. Removes 111 Orkney from the "supposed errors []" in Watson, "Top. Bot.," ed. ii, p. 123 (1883). Confirms the record of this species as an alien in Orkney in Barry's "History of the Orkney Islands," second edition, p. 285 (1808), under the name of "Ervum *Hirsutum*." See "Journ. Bot.," No. xiii, p. 14 (January 1864); "Scot. Nat.," No. xlvii, p. 326 (July 1882); Watson, "Top. Bot.," ed. ii, p. 123 (1883), in which the supposed error "[]" should be deleted; "Annals Scot. Nat. Hist.," No. 26, p. 107 (April 1898), in which "111 (?)" should be deleted; and Spence, "Flora Orcadensis," p. 18 (1914).

Alchemilla vulgaris, *Linn., var. b.* alpestris, *Pohl* (*fide* Arthur Bennett).—Burnside, Naversdale, Orphir, Mainland, 16th July 1877 and 31st July 1879, H. H. Johnston; and natural pasture near a loch, 55 feet above sea-level, Hobbister, Loch of Kirbister, Orphir, Mainland, 3rd August 1920, H. H. Johnston. Native and rare at both these stations. Confirms the late Rev. E. S. Marshall's record of this variety from Orkney ("near Stromness") in "Journ. Bot.," vol. xxxix, p. 268 (August 1901); and the

late Mr. A. Somerville's record for it from Sanday, 1898, in "Trans. Bot. Soc. Edin.," vol. xxvii, p. 55 (1916).

Rosa mollissima, *Willd., var. d.* pseudo-rubiginosa (*Lej.*). [=R. mollissima, *Willd., var. c.* suberecta of "Lond. Cat." ed. vii (1874); R. mollis, *Sm., var. d.* pseudo-rubiginosa (*Lej.*) of "Lond. Cat." ed. x (1908), where this variety is erroneously placed under Rosa omissa, *Déségl.*; and R. arduennensis, *Crép.*] (*fide* William Barclay).—Grassy banks at burnside, 20 feet above sea-level, Wideford Burn, Saint Ola, Mainland, 23rd July 1920 and 16th September 1920, H. H. Johnston. Native. Petals white. Ripe fruit scarlet, with persistent sepals.

Rosa canina, *Linn., var.* fugax (*Gren.*) [=R. glauca, *Vill., var. h.* fugax (*Gren.*) of "Lond. Cat." ed. x (1908)] (*fide* William Barclay).—Heathery banks at burnside, 90 feet above sea-level, South Burn, Hoy, 1st October 1920, H. H. Johnston. Very rare. Leaves glabrous beneath. Ripe fruit dull yellowish-red, with persistent sepals. With reference to my specimens of this species, Mr. William Barclay, in a note, dated 8th November 1920, writes as follows:—"The fruits on the later collected specimen have developed and ripened fairly well. The tendency of the prickles to grow in little groups is noteworthy." My specimens in ripe and unripe fruit were collected from the same plant on the same date.

[*Fuchsia Riccartoni*, Hort. Am bor. Cult. (*fide* G. C. Druce).—Rocky burnside, 300 feet above sea-level, Syradale, Firth, Mainland, 23rd September 1920, H. H. Johnston. Not native. Planted. Two plants only seen by me, one below the waterfall in the Burn of Eskadale, on the north side of Syradale, from which my specimen was taken, and the other one on a grassy bank, 350 feet above sea-level, at Syradale Burn. The latter shrub was planted by Mr. William Towers in March 1914, but he does not know the name of the person who planted the other shrub below the waterfall, which has been there for a considerable time prior to 1914.]

Ribes nigrum, Linn.—Grassy banks at burnside, 20 feet above sea-level, near the Mill of Firth, Mainland, 20th May 1920, H. H. Johnston. Not native. One plant, in full flower, only seen by me.

Myrrhis Odorata, Scop.—Artificial pasture at roadside, 70 feet above sea-level, Finstown, Firth, Mainland, 22nd May 1920, H. H. Johnston. Not native. An escape from a garden. Rare.

Leontodon autumnalis, *Linn., var. d.* simplex, *Duby* (*fide* Arthur Bennett).—Damp natural pasture, 30 feet above sea-level, Deepdale, Stromness, Mainland, 14th August 1920, H. H. Johnston. Native. Common. Plants in full flower. Leaves with a few hairs on both surfaces. Phyllaries clothed with greenish-black hairs. Style and its two branches yellowish-brown; and short, natural pasture, 15 feet above sea-level, west of the United Free Church, North Ronaldsay, 21st August 1920. Native. Common. Plants in full flower. Leaves thinly hairy on both surfaces. Scapes 1–2, decumbent, 1-headed. Phyllaries clothed with greenish-black hairs. Corolla yellow, or yellow above and striped dull crimson beneath. Style and its two branches yellowish-brown. Confirms the record of this variety from Orkney ("Ward Hill, Orphir") in Spence, "Flora Orcadensis," p. 43 (1914).

Taraxacum spectabile, *Dahlst, var.* maculigerum, *Dahlst.* (*fide* G. C. Druce). Grassy banks at seashore, 10 feet above sea-level, Hamla Voe, Stromness, Mainland, 19th May 1920, H. H. Johnston. Native. Very common. Plants in full flower. Leaves dull green above, paler green beneath. Outer phyllaries recurved both in flower-bud and in the fully-expanded flowers; inner phyllaries not appendaged at the apex. Fruit brown.

Chrysanthemum Parthenium, Pers. (*fide* J. Hutchinson).—Side of a footpath outside a garden, 90 feet above sea-level, Daisybank, Kirkwall, Saint Ola, Mainland, 23rd July 1920, H. H. Johnston. Not native. An escape from Daisybank garden. Very rare. Corolla of ray-florets white.

Anaphalis margaritacea, Benth. et Hook. fil. [= *Gnaphalium margaritaceum*, Linn.] (*fide* G. C. Druce).—Banks at burnside, 140 feet above sea-level, Burn of Beaquoy, near The Wilderness, Birsay, Mainland, 9th August 1920, H. H. Johnston; and grassy banks at burnside, 200 feet above sea-level, Burn of Vinden, Firth, Mainland, 23rd September 1920, H. H. Johnston. Not native. Very rare at both stations.

*Mimulus Langsdorfii, *Donn* [=*M. luteus, *Linn.*].—Wet burnside, 120 feet above sea-level, Caldale, Saint Ola, Mainland, 22nd July 1920, H. H. Johnston; and wet burnside, 10 feet above sea-level, Swanbister Burn, Orphir, Mainland, 3rd August 1920, H. H. Johnston. Naturalised at both stations. Very rare at Caldale, but common at Swanbister Burn. Corolla yellow.

Veronica Tournefortii, C. Gmel. [=*V. Buxbaumii*, Ten.].—Garden, 60 feet above sea-level, Schoolhouse, Kirbister, Orphir, Mainland, 3rd August 1920, H. H. Johnston. Not native. A weed of cultivation. Rare. Confirms the record of this species as an alien from Orkney in "Annals Scot. Nat. Hist.," No. 30, p. 96 (April 1899). See Bennett, "Suppl. Top. Bot.," ed. ii, p. 60 (1905); and Spence, "Flora Orcadensis," p. 52 (1914).

Euphrasia Kerneri, *Wettst.* (*fide* Cedric Bucknall).—Shell-sandy natural pasture near seashore, 10 feet above sea-level, Backaskaill Bay, Cross, Sanday, 29th August 1920, H. H. Johnston. Native. Very common. Plants in full flower. Leaves 2–6 toothed. Corolla pale whitish lilac-purple, with dark purple lines, and a yellow spot on throat of lower lip. A new record for H. C. Watson's county No. 111 Orkney.

Euphrasia caerulea, *Tausch* (*fide* Cedric Bucknall).—Wet natural pasture on hillside, 300 feet above sea-level, Wart Hill, Hoy, 15th August 1912, 1st September 1919, and 31st July 1920, H. H. Johnston. Native. Common. Plants growing among Euphrasia scottica, *Wettst.*, which has a smaller corolla than that of E. caerulea, *Tausch*. Leaves 2–10 toothed. Corolla lilac, with dark purple lines, and a yellow spot on throat of lower lip. A new record for H. C. Watson's county No. 111 Orkney, and also new to the British flora. The specimens collected by me on 15th August 1912 were erroneously recorded as "Euphrasia curta, *Wettst., var. b.* glabrescens, *Wettst.*" (*fide* E. S. Marshall), in "Bot. Exch. Club Report for 1912," p. 273 (1913); "Trans. Bot. Soc. Edin.," vol. xxvi, p. 215 (1914); and Spence, "Flora Orcadensis," p. 134 (1914). See "Corrections."

Rhinanthus major, Ehrh. (name confirmed by Arthur Bennett).—Shell-sandy vetch and oat field, 15 feet above

sea-level, Galilee, North Loch, Lady, Sanday, 27th August 1920, H. H. Johnston. Not native. A weed of cultivation. Rare. Calyx pale yellow. Central lobe of upper lip of corolla dark purple; two lateral lobes oblong, longer than broad, yellow. Confirms the record of this species from Orkney in "Annals Scot. Nat. Hist.," No. 30, p. 97 (April 1899); Bennett, "Suppl. Top. Bot.," ed. ii, p. 60 (1905), where, Mr. Arthur Bennett, in a post-card dated 18th February 1921, informs me, the reference "Sc. Nat. 1883, 73" is wrong, and it should *read* "Annals Scot. Nat. Hist.," No. 30, p. 97 (April 1899); and Spence, "Flora Orcadensis," p. 53 (1914).

AJUGA REPTANS, *Linn.* × PYRAMIDALIS, *Linn.* (*fide* G. C. Druce and Arthur Bennett).—Dry heathery and grassy hillside (burnt within the past few years) facing the south, 290 feet above sea-level, north side of Syradale, Firth, Mainland, 20th May 1920, H. H. Johnston. Native. Rare. Plants in full flower growing among typical AJUGA PYRAMIDALIS, *Linn.*, and in the same valley with AJUGA REPTANS, *Linn.*, which I collected near the same place on 17th August 1883, and quarter of a mile distant on 6th September 1919. This hybrid resembles A. REPTANS, *Linn.*, in having stolons which are shorter than those of that species, the leaves are subglabrous or have a few short hairs on both surfaces and longer hairs on the margins, the whorls of flowers are arranged in laxer pyramidal spikes than those of A. PYRAMIDALIS, *Linn.*, and the corolla is blue, with the middle lobe of the lower lip slightly emarginate. In my specimens of A. PYRAMIDALIS, *Linn.*, collected at the same station, on 20th May 1920 and 29th July 1920, the leaves and bracts are very hairy on both surfaces in most of the plants, but in other plants they are only moderately hairy on both surfaces. Mr. Arthur Bennett informs me that the above-mentioned hybrid is recorded in Foche, "Pflanzen Mischlinge," p. 341 (1881), and in other European botanical works.

SCUTELLARIA GALERICULATA, *Linn.*—Artificial heap of stones at seashore, 10 feet above sea-level, Sennes, Garsow Wick, North Ronaldsay, 21st August 1920, H. H. Johnston. Native. Rare. Plants in full flower. Corolla blue. On

20th August 1920, Mr. John Scott, Northmanse, North Ronaldsay, informed me that he first saw the Skull-cap growing on the seashore, at Garsow Wick, outside the stone wall that surrounds the island of North Ronaldsay, about the year 1880; but that since then it has disappeared from the seashore outside the wall, and now grows inside the wall among a long artificial heap of stones. Confirms the records of this species from Orkney in "Annals Scot. Nat. Hist.," No. 68, p. 251 (October 1908); and Spence, "Flora Orcadensis," p. 55 (1914).

Plantago lanceolata, *Linn., var.* decumbens, *Lange* (*fide* G. C. Druce).—Shell-sandy links at seashore, 10 feet above sea-level. Links of Skaill, Sandwick, Mainland, 4th August 1920, H. H. Johnston. Native. Common. Dr. G. C. Druce informs me that this is the same plant as that erroneously recorded as "Plantago media" in Edmondston's "Flora of Shetland," p. 17 (1845).

Chenopodium hybridum, Linn. (*fide* G. C. Druce).—Gravelly ground round filter beds, 200 feet above sea-level. Kirkwall Waterworks Reservoir, near Hatston, Saint Ola, Mainland, 9th August 1920, H. H. Johnston. Not native. Very rare. Plants neither in flower nor fruit.

Atriplex laciniata, *Linn.* [= A. arenaria, *Woods.*] (*fide* Arthur Bennett).—Shell-sandy seashore, 5 feet above sea-level, Backaskaill Bay, Cross, Sanday, 25th August 1920. H. H. Johnston. Native. Common. Plants in full flower. Leaves green above, whitish-green beneath, mealy white on both surfaces, especially the lower. Flowers with an offensive odour. Perianth segments 5. Stamens 5. Confirms the record of this species for H. C. Watson's county No. 111 Orkney in Neill, "Tour," p. 188 (1806), where it is recorded as growing on "seashores, rarely." See "Journ. Bot.," No. xiii, p. 20 (January 1864), where Mr. H. C. Watson has placed this species in his "list of omitted species": "Annals Scot. Nat. Hist.," No. 30, p. 101, where the record for Orkney is shown as "111 (?)"; and Spence, "Flora Orcadensis," p. 61 (1914).

Atriplex patula, Linn., var. d. *bracteata*, Westerlund (*fide* G. C. Druce).—Gravelly ground round filter beds,

200 feet above sea-level, Kirkwall Waterworks Reservoir, near Hatston, Saint Ola, Mainland, 9th August 1920 and 9th October 1920, H. H. Johnston. Not native. Very rare.

SALIX AURITA, *Linn.* × CINEREA, *Linn.* ♀ (*fide* G. C. Druce and Arthur Bennett).—Heathery banks at burnside, 90 feet above sea-level, South Burn, Hoy, 30th August 1919 (plants in leaf only), 7th May 1920 (plants in full flower), and 12th June 1920 (plants in leaf and unripe fruit), H. H. Johnston. Native. Rare. An erect, much-branched shrub, 3 feet high, with the lower part of the stems submerged in running water in a burn. Both parents grow along the banks of the South Burn in the same neighbourhood. All my three gatherings of specimens were collected from the same individual plant.

SALIX REPENS, *Linn., form.* ARGENTEA (*Sm.*) ♂ [= *var. g.* ARGENTEA (*Sm.*) of "Lond. Cat.," ed. vii (1874)] (*fide* Arthur Bennett).—Heathery crags on hillside, 520 feet above sea-level, north-east side of Cuilags, Hoy, 1st September 1919 (plants in leaf only) and 11th June 1920 (plants in leaf and flower, with the stamens mostly withered), H. H. Johnston. Native. Rare. Both my gatherings of specimens were collected from the same individual plant. Confirms the record of this form or variety from Orkney ("Sanday") in Neill, "Tour," p. 189 (1806). See "Scot. Nat.," No. i, new series, p. 23 (July 1883).

MYRICA GALE, *Linn.*—Ditch, near the old Established Church, Eday, 13th June 1920, Miss Ann J. H. Marwick. Confirms the record of this species for H. C. Watson's county No. 111 Orkney by Mr. J. R. Hebden in Dr. A. R. Duguid's manuscript "Flora Orcadensis" (1858). See "Scot. Nat.," No. i, new series, p. 22 (July 1883); "Annals Scot. Nat. Hist.," No. 31, p. 166 (July 1899); Bennett, "Suppl. Top. Bot.," ed. ii, p. 76 (1905); and Spence, "Flora Orcadensis," p. 66 (1914).

CLASS II.—MONOCOTYLEDONS.

ORCHIS MACULATA, *Linn.* [ORCHIS FUCHSII, *Druce* (*fide* G. C. Druce, 4th August 1920)]. — Pasture at burnside, 30 feet above sea-level, Wideford Burn, Saint Ola, Mainland, 23rd July 1920 and 16th September 1920, H. H.

Johnston. Native. Rare. Stem *solid*. Leaves *spotted* dark purplish-black on upper surface. Perianth *pale purple*, with dark purple lines on lip; two lateral sepals *spreading*; upper sepal and two petals connivent; lip *flat* and 3-lobed, with a *large* middle lobe, *longer* than the two lateral lobes, and *straight* (not *recurved* at the apex as in the subspecies O. ERICETORUM, *Linton*). ORCHIS MACULATA, *Linn.*, is recorded for H. C. Watson's county No. 111 Orkney in Watson, "Top. Bot.," ed. ii, p. 390 (1883), but there is no doubt but that this record was based on plants of the *subspecies* O. ERICETORUM, *Linton*, which is very common in Orkney. Since I began to collect botanical specimens in Orkney in 1874, I have seen many thousands of plants of O. ERICETORUM, *Linton*, in several different islands, but the only plants of O. MACULATA, *Linn.* I have seen in Orkney are those I found at Wideford Burn on 23rd July 1920. In the opinion of Dr. G. Claridge Druce, the *subspecies* O. ERICETORUM *Linton*, is the true type of O. MACULATA, *Linn.*, "Species Plantarum," 1335, and my specimens from Wideford Burn belong to another species, which he has named O. FUCHSII, *Druce*. In O. ERICETORUM, *Linton*, the middle lobe of the lip is *smaller*, *shorter*, and *narrower* than the two lateral lobes, and *recurved* at the apex, whereas in O. FUCHSII, *Druce*, it is *larger* and *longer* than the two lateral lobes, and the apex is *not* recurved. See "Trans. Bot. Soc. Edin.," vol. xxviii, p. 39 (1920).

Narcissus Pseudo-narcissus, Linn. (*fide* C. H. Wright).—Grassy bank at lochside, 140 feet above sea-level, Loch of Wasdale, Firth, Mainland, 22nd May 1920, H. H. Johnston. Not native. Five small clumps of plants only seen by me.

Scilla non-scripta, Hoffmgg. et Link [=*Scilla nutans*, Sm., and *Endymion nutans*, Dum.].—Grassy banks at seashore, 5 feet above sea-level, Isgarth, Lady, Sanday, 27th May 1920, H. H. Johnston. Not native. An escape from the garden of Isgarth House. One small clump of plants, in flower, seen by me. Perianth blue. Confirms the record of this species from Orkney in Bennett, "Suppl. Top. Bot.," ed. ii, p. 82 (1905). This species is cultivated in gardens in Orkney, but it is not native, nor has it become naturalised anywhere in the county, so far as I am aware.

CAREX TERETIUSCULA, *Good.* [=C. DIANDRA, *Schrank*] (*fide* G. C. Druce and Arthur Bennett).—Swamp, 130 feet above sea-level, Dee of Durkadale, Birsay, Mainland, 4th August 1920, H. H. Johnston. Native. Rare. A new record for H. C. Watson's county No. 111 Orkney. Mr. G. W. Scarth, in *litt.*, dated 19th September 1919, informs me that the last time he visited the Dee of Durkadale he saw "what looked very like CAREX TERETIUSCULA, *Good.*," but the plants were not in fruit, and he did not preserve specimens of them.

AGROSTIS VULGARIS, *With., var. b.* PUMILA (*Lightf.*) (*fide* G. C. Druce).—Pasture, 170 feet above sea-level, Binscarth, Firth, Mainland, 6th August 1920, H. H. Johnston; and grassy and heathery pasture, 10 feet above sea-level, Point of Onston, Stenness, Mainland, 9th August 1920, H. H. Johnston. Native. Rare at Binscarth and common at the Point of Onston. Confirms the record of this variety from Orkney in Neill, "Tour," p. 184 (1806). See "Scot. Nat.," No. ii, new series, p. 74 (October 1883); "Annals Scot. Nat. Hist.," No. 64, p. 227 (October 1907); and Spence, "Flora Orcadensis," pp. xxv and 86 (1914).

AGROSTIS ALBA, *Linn., var. d.* COARCTATA (*Hoffm.*) (*fide* G. C. Druce and Arthur Bennett).—Short natural pasture near edge of sea-cliffs, 250 feet above sea-level, Black Crag, Stromness, Mainland, 7th August 1920, H. H. Johnston. Native. Common. Confirms Mr. G. W. Scarth's record of this variety from Orkney in Spence, "Flora Orcadensis," p. 86 (1914).

KOELERIA BRITANNICA, *Domin* [=K. GRACILIS, *Pers., var. c.* BRITANNICA, *Domin* (K. CRISTATA, *Pers.* ed. 9) of "Lond. Cat.," ed. x (1908)] (*fide* G. C. Druce).—Grassy banks at lochside, 30 feet above sea-level, Kierfiold, Loch of Skaill, Sandwick, Mainland, 4th August 1920, H. H. Johnston; natural shell-sandy pasture at seashore, 10 feet above sea-level, Links of Boardhouse, Birsay, Mainland, 4th August 1920, H. H. Johnston; and short natural pasture near edge of sea-cliffs, 240 feet above sea-level, Black Crag, Stromness, Mainland, 7th August 1920, H. H. Johnston. Native. Common at all these three stations. Confirms the record of this *subspecies* for H. C. Watson's county No. 111 Orkney, as KOELERIA CRISTATA, *Pers.*, in

"Annals Scot. Nat. Hist.," No. 33, p. 39 (June 1900); "Journ. Bot.," vol. xxxix, p. 274 (August 1901); and Bennett, "Suppl. Top. Bot.," ed. ii, p. 104 (1905); and as Koeleria britannica, *Domin*, in "Annals Scot. Nat. Hist.," No. 57, p. 32 (January 1906); and *ibid.*, No. 64, p. 227 (October 1907).

Class III.—Cryptogams.

Cystopteris fragilis, *Bernh.*, *var. b.* dentata, *Hook.*—Clefts of sandstone crags on hillside, 460 feet above sea-level. Dwarfie Hamars, Hoy, 5th August 1920, H. H. Johnston. Native. Rare. Confirms the record of this variety for H. C. Watson's county No. 111 Orkney in "Annals Scot. Nat. Hist.," No. 34, p. 105 (April 1900); and "Journ. Bot.," vol. xxxix, p. 275 (August 1901). I have also collected specimens of the type of the species C. fragilis, *Bernh.*, at two different places on the Wart Hill, Hoy, on 10th July 1877 and 14th June 1920, where it is native and rare and reaches an altitude of 730 feet above sea-level.

Equisetum pratense, *Ehrh.* (*fide* C. H. Wright).—Damp natural shell-sandy pasture, Links of the Hall of Sands, Deerness, Mainland, 19th August 1916, H. H. Johnston. Native. Moderately common. Plants with sterile stems only. Confirms the record of this species for H. C. Watson's county No. 111 Orkney in "Annals Scot. Nat. Hist.," No. 67, p. 170 (July 1908); and Spence, "Flora Orcadensis," p. 97 (1914).

Chara desmacantha, *J. Groves et Bullock-Webster* (*fide* James Groves).—Shell-sandy mud at bottom of water, 1 inch deep, in a loch near the sea, 8 feet above sea-level, Loch of The Rive, Burness, Sanday, 28th August 1920, H. H. Johnston. Native. Common. Plants fetid. "A sterile form with well-developed bulbils" (*fide* J. Groves). Confirms the late Rev. E. S. Marshall's record of this species from Orkney (Loch of Stenness and Loch of Harray in Mainland) in "Journ. Bot.," vol. xxxix, p. 275 (August 1901). See "Annals Scot. Nat. Hist.," No. 64, p. 230 (October 1907); and under the next species, p. 65.

Chara hispida, *Linn.* (*fide* James Groves).—Shell-sandy mud at bottom of water, 2 inches deep, in a nearly dried-

up loch, 10 feet above sea-level, Loch of Langamay, Lady, Sanday, 27th August 1920, H. H. Johnston; and shell-sandy mud at bottom of water, 3 inches deep, in a loch near the sea, 8 feet above sea-level, Loch of The Rive, Burness, Sanday, 28th August 1920, H. H. Johnston, "a very neat form with the cortical cells of almost equal diameter" (*fide* J. Groves). Native and common at both stations, especially at the Loch of Langamay, where nearly the whole of the bed of the loch was densely covered with it at the time of my visit. Confirms the record of this species from Orkney (Loch of Airy in Stronsay) in Neill, "Tour," p. 184 (1906). See "Journ. Bot.," No. xiii, p. 17 (January 1864); "Scot. Nat.," No. iii, new series, p. 114 (January 1884), where this species is recorded from Brogar on the authority of the late Dr. A. R. Duguid, but a specimen collected by me in the Loch of Harray, near the Bridge of Brogar, Stenness, Mainland, on 24th September 1880, and named "CHARA HISPIDA, *Linn.*," by the late Dr. J T. I. B. Boswell, has been identified as C. DESMACANTHA, *J. Groves et Bullock-Webster*, by Mr. James Groves; "Annals Scot. Nat. Hist.," No. 34, p. 107 (April 1900); and Spence, "Flora Orcadensis," p. 98 (1914). Specimens of C. HISPIDA, *Linn.* (*fide* James Groves), were collected at the Loch of Langamay ("Longmay marshy loch"), Sanday, on 20th July 1898, by the late Mr. A. Somerville, and I have seen them in the herbarium of Mr. James Groves.

CHARA RUDIS, *Leonhardi* (*fide* James Groves).—Shell-sandy mud at the bottom of water, 2 inches deep, in a nearly dried-up loch, 10 feet above sea-level, Loch of Langamay, Lady, Sanday, 27th August 1920, H. H. Johnston. Native. Plants growing among C. HISPIDA, *Linn.* "Very characteristic" (*fide* J. Groves). The secondary cortical cells of the stem are much greater in diameter than the primary cortical cells. A new record for H. C. Watson's county No. 111 Orkney.

CHARA CANESCENS, *Loiseleur* (*fide* James Groves).—Mud at bottom of brackish water, 5 feet deep, in a loch at sea-level, near the *noust* for boats, Nether Bigging, Loch of Stenness, Mainland, 14th September 1920, H. H. Johnston. Native. Common. With reference to my specimens of this species, Mr. James Groves, in a note dated 18th Nov-

ember 1920, writes as follows:—"This represents an important extension of the range of the species in the British Isles. It is a form with unusually short branchlets. The fruits, of which very few are developed, are shorter and broader than in other British forms." On 2nd August 1920, when in company with Dr. G. Claridge Druce, and searching for specimens of Chara baltica, *Bruzel*, for him, I raked up plants of C. canescens, *Linn.*, and Tolypella nidifica, *Leonhardi*, which Dr. Druce preserved; but, not being aware at the time what they were, I did not preserve specimens of them myself, and it was only after Dr. Druce's specimens had been identified by Mr. James Groves that I knew what their names were, and that both of them were new records for H. C. Watson's county No. 111 Orkney, as published by Dr. Druce in "Bot. Exch. Club Secretary's Report for 1919," Addenda 1920, p. 730 (October 1920).

Tolypella nidifica, *Leonhardi* (*fide* James Groves).—Mud at bottom of brackish water, 5 feet deep, in a loch at sea-level, near the *noust* for boats, Nether Bigging, Loch of Stenness, Stenness, Mainland, 2nd August 1920, G. C. Druce; and 14th September 1920, H. H. Johnston. Native. Common. Plants in fructification. My largest specimen measures 16 inches (40 cm.) in length. With reference to my specimens, Mr James Groves, in a note dated 18th November 1920, writes as follows:—"The first record of the plant for Britain. I have little doubt that the Tolypella collected in Orkney by Mr. A. H. Evans, and recorded as T. glomerata, *Leonhardi*, belonged to this species, but the specimens had only small unripe fruit." Mr. A. H. Evans collected his specimens in the Loch of Stenness in 1911. A new record for H. C. Watson's county No. 111 Orkney, published by Dr. G. C. Druce in "Bot. Exch. Club Secretary's Report for 1919," Addenda 1920, p. 730 (October 1920).

Some Moss Records from St. Kilda. By William Evans, F.R.S.E.

(Read 20th January 1921.)

For reasons one can readily appreciate an island is always a place of interest to the naturalist, and the more remote and inaccessible the greater the interest it arouses. Lying out in the Atlantic, some 40 miles west of Harris, St. Kilda was bound to attract attention, and the chief features of its fauna and flora are already known. Much has been written regarding its wonderful avi-fauna, and in the cataloguing of the insects and other invertebrates considerable progress has been made. The flora, too, has been fairly well investigated as regards the flowering plants and ferns by R. M. Barrington (Journ. of Bot., 1886, p. 213) and A. H. Gibson (Trans. Bot. Soc. Edin., xix, 1891, p. 155). So far as I know, however, the only mosses specifically recorded are three mentioned by James Murray in a note on "Microscopic Life of St. Kilda" (Ann. Scot. Nat. Hist., 1905, p. 94), and three others given in a paper by Dr. C. Gordon Hewitt entitled "A Contribution to a Flora of St. Kilda; being a List of certain Lichens, Mosses, Hepaticae, and Fresh-Water Algae" (ibid., 1907, p. 239).

In June 1905 the Rev. James Waterston, B.Sc., visited St. Kilda and brought back a number of mosses which were submitted to the late Mr. James M'Andrew, a list of whose determinations was given to me by Mr. Waterston, and also one or two additional specimens he collected in 1906. While staying at St. Kilda in September 1911 Dr. W. Eagle Clarke procured some samples of moss for me, and from this material further records were obtained. From the above sources the following list has been drawn up, the letters after each species referring to the name of the collector.

The number of species in the present list is 32, three of them being additions to the Outer Hebrides (V.C. 110) list as shown in the 1907 "Census" of British Mosses. There is a tendency to departure from type in several of the

species, and capsules seem to be but rarely produced. Our information on these and other points is, however, meagre, and it is to be hoped that a fuller knowledge of the Moss-flora of St. Kilda and its attendant islands may be forthcoming before many years are over. My own only attempt to land on St. Kilda was frustrated by a south-easterly gale which caused a heavy sea to run right into Village Bay, where the landing-place is.

Sphagnum cymbifolium, Ehrh.—W.
—— *acutifolium*, Ehrh.—W.
Polytrichum urnigerum, Linn.—C.
—— *juniperinum*, Willd.—W.
—— *commune*, Linn.—W.
Campylopus flexuosus, Brid.—C.
Dicranum scoparium, Hedw.—W., C.
Leucobryum glaucum, Schp.—W.
Fissidens adiantoides, Hedw.—H. Not in "Census" for V.C. 110.
Grimmia apocarpa, Hedw.—M. Not in "Census" for V.C. 110.
Rhacomitrium aciculare, Brid.—M.
—— *fasciculare*, Brid.—W., C.
—— *lanuginosum*, Brid.—W., C.
Ulota phyllantha, Brid.—C.
Breutelia arcuata, Schp.—C.
Mnium hornum, Linn.—H., W., C.
Fontinalis antipyretica, Linn.—M., W.
Pterygophyllum lucens, Brid.—H.
Thuidium tamariscinum, B. & S.—W.
Brachythecium purum, Dixon—C.
Eurhynchium praelongum, Hobk.—W., C.
—— *myosuroides*, Schp.—C.
—— *myurum*, Dixon—W., C.
Plagiothecium undulatum, B. & S.—W., C.
Hypnum stellatum, Schreb.—W.
—— *cupressiforme*, Linn.—W.
—— —— var. *ericetorum*, B. & S.—C. Not in "Census" for V.C. 110.
—— *callichroum*, Brid.—W. Not in "Census" for V.C. 110.

Hypnum cuspidatum, Linn.—W.
—— *Schreberi*, Willd.—W.
Hylocomium splendens, B. & S.—W., C.
—— *loreum*, B. & S.—W., C.
—— *squarrosum*, B. & S.—W., C.

Craigia, a new Genus of Sterculiaceae.

By W. W. Smith, M.A., and W. Edgar Evans, B.Sc. (With Pl. I.)

(Read 17th February 1921.)

Craigia, W. W. Sm. et W. E. Ev. Genus novum Sterculiacearum.

Genus inter Sterculiaceas androecii characteribus bene notatum; petalis nullis, tubo staminali vix evoluto vel ad circulum nigrum reducto (unde oriuntur stipites quinque sepalis alterni qui stamina vulgo quatuor atque processus duos (? staminodia) lanceolatos, unum posteriorem alterum anteriorem, stamina includentes gerunt) ab affinibus recognoscitur. Ad Buettnerieas vel ad Lasiopetaleas spectat sed sectione nova dignum esse videtur.

Arbor vel frutex, pube stellata pilis simplicibus mixta. Folia alterna indivisa penninervia. Inflorescentia axillaris cymoso-paniculata. Flores hermaphroditi. Calycis segmenta 5 libera valvata. Petala nulla. Stamina anomala ut supra indicata. Antherae biloculares loculis parallelis. Ovarium liberum 5-loculare. Styli 5 a basi liberi. Ovula multa fere horizontalia semi-anatropa. Fructus deest.

Genus monotypicum in provincia Yunnan crescens.

Craigia yunnanensis, W. W. Sm. et W. E. Ev. Sp. nov.

Arbor parva 6–10·5 m. alta. Ramuli crassi primo dense ferrugineo-stellato-tomentosi, tandem glabrescentes lenticellis subcircularibus albidis bene conspersi. Folia petiolo 3·5–5 cm. longo tomentoso munita; lamina vulgo 12–15 cm. longa, 8–11 cm. lata, ovata, apice breviter acutata, basi paulo cordata vel subtruncata, margine denticulis crebris subregulariter praedita, in sicco papyracea tactu aspera,

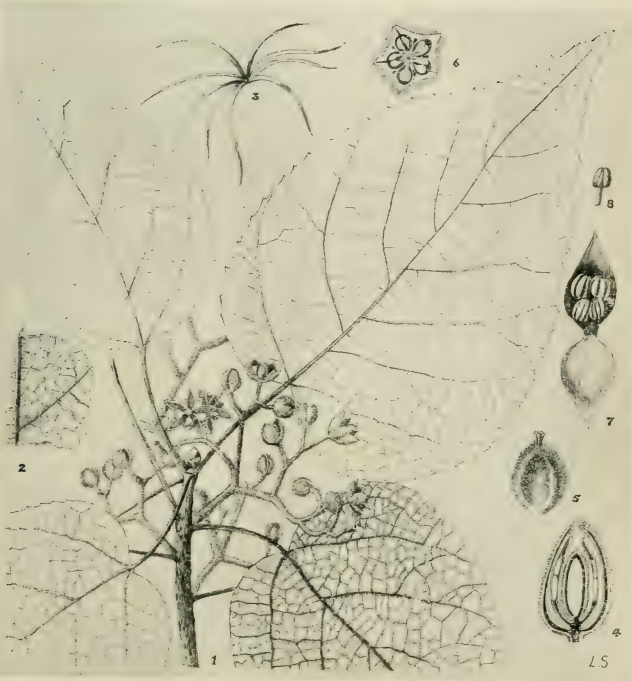
supra in maturitate ad costam nervosque dense stellato-tomentosa ceteroquin sparsim, infra pilis stellatis subferrugineis vel fulvidis ubique densiuscule induta; nervi vulgo 7–8 paria utrinque paulo eminentes. Inflorescentiae 4–6 cm. longae foliis multo breviores cymoso-paniculatae 20–40-florae; pedunculi primarii breves cum pedicellis circ. 5 mm. longis dense fulvo-stellato-tomentosi. Sepala 5 libera valvata circ. 7 mm. longa, ovato-lanceolata, subacuta, textura firma, extra et ad marginem intus fulvo-tomentosa; pars media faciei interioris lanceolata indumento tenuiore signata. Petala desunt. Tubus staminalis ad circulum nigrum reductus a quo procedunt stipites quinque nigri circ. 1 mm. longi quorum ad apices stamina vulgo quatuor inserta antheris bilocularibus vix 1 mm. longis longitudinaliter dehiscentibus filamenta glabra subaequantibus; sub insertione staminum processus duo (staminodia ?), unus anterior, alter posterior, circ. 4 mm. longi, lanceolati, submembranacei, appressi atque stamina omnino includentes. Ovarium ovoideum circ. 3 mm. longum dense fulvo-tomentosum 5-loculare ovulis multis angulo interiori affixis anatropis; styli 5 liberi circ. 1 mm. longi.

"West China: — Mekong-Salween divide, Yunnan, in mixed thickets in side valleys. Lat. 26° 10′ N. Alt. 8000 ft. Shrub of 20–35 ft. Flowers deep creamy yellow. July 1919." G. Forrest. No. 18,409.

"Shweli valley, Yunnan, in forests. Lat. 25° N. Alt. 5000 ft. Tree of 30–50 ft. Perianth thick and fleshy, exterior dull pale brown with a short pubescence, interior dull lake; anthers golden-yellow, in fours enclosed in pairs of small leafy bracts which are deep brown; ovary green. July 1912." G. Forrest. Nos. 8841, 8253.

In foliage and inflorescence *Craigia* recalls certain species of Sterculia. The androecium is characteristic. The staminal ring is not developed but is represented by a black circular band from which arise five short stalks bearing two lanceolate petal-like structures, probably staminodes, appressed to one another and each pair closely enveloping a group of four stamens.

The generic name is in honour of William Craig, M.D., F.R.C.S.Ed., F.R.S.E., Honorary Secretary of the Botanical Society from 1900-1912; President of that Society for



Craigia yunnanensis, W. W. Sm. et W. E. Ev.

1887–1889; at one time lecturer on Materia Medica in the Royal College of Surgeons; a member of the Scottish Alpine Botanical Club; and an enthusiastic student of the flora of Scotland.

EXPLANATION OF PLATE I.

1. Inflorescence, $\times \frac{1}{2}$.
2. Underside of leaf, $\times 2$.
3. Hair on underside of leaf, highly magnified.
4. Longitudinal section of flower bud.
5. Ovary, $\times 3$.
6. Cross-section of ovary, $\times 4$.
7. A staminal stipe opened up, $\times 3$.
8. Stamen.

Pyrola rotundifolia, Linn., in Caithness, with Notes on the Genus. By Arthur Bennett, A.L.S.

(Read 10th December 1920.)

In June 1920 Mr. Bain sent me a specimen of a *Pyrola*, remarking that it seemed different from the *P. media* of the Wick river banks. It was in poor condition, but I at once thought it *rotundifolia*, writing Mr. Bain so with a query. In a week he sent me 6 specimens, and 6 of *media*, all in splendid order. There was now no doubt it was not *media*, but the colour of the flowers—greenish-white with green veins—suggested *P. chlorantha*, though the calyx segments and anther cells denied this. All other *rotundifolia* I had gathered (and that many) were white-flowered, and all the books say white. Colonel Johnston writes me that the Orkney plant has white flowers. On referring to the Scandinavian Floras one finds a var. *chloranthoides*, Norrlin (Fl. Kareliae Onegensis, ex Faun. Flor. Fenn. Notiser, xiii, 1871–4, p. 160) and a f. *chloranthiflora*, Noto in herb. = var. *pumila*, A. Bl. (Norges Flora, 1906, p. 550) (not of Hornem., which is *P. grandiflora*, Radius, and has smaller leaves, and a greenish flower, etc.). The forma occurs in Russian Lapland (Lapponia ponojensis), *c.* 67° N. lat., and in the province Kuusamo, and also at Seida ad Tenojoki in E. Finmark, Norway, the type being found in the whole of

Finland except one extreme northern province (Lapponia murmarica). The Caithness specimens agree with the Norwegian f. *chloranthiflora*, and Hjelt (Flora Fennica, v, 1919, p. 345) says that perhaps his var. *chloranthoides* may be the Norwegian f., or it may be a local form.

It grows in Caithness, 7 miles west of Wick, on the banks of the Strath Burn, a tributary of the Wick river, between Strath and Scorriclett. At this point the vegetation is luxuriant. Dr. Crampton, in his Vegetation of Caithness (1911, p. 95), giving a list of 49 representative species, includes among them *Erica cinerea*, *Vaccinium Myrtillus*, *Salix repens*, and *Luzula sylvatica*. The banks of the river rise to 20–30 feet on either side, and are composed of Calcareous Flagstones and Shelly Boulder Clay (Crampton, *l.c.*). *P. media* grows near, as Mr. W. Sutherland sent me specimens some years ago from Scorriclett. We know that *rotundifolia* occurs in the Orkneys, but *media* is recorded from Shetland. Mr. Sherrin, the Curator of the South London Botanical Institute writes me: "There is no *Pyrola* in the late Mr. Beeby's collection of Shetland plants." Edmonston at first recorded *rotundifolia* from Shetland, but in his Flora altered it to *media*, and in the second edition of the Flora (1903), p. 74, it still stands as *media*. All the Caithness *media* had the flowers with a decidedly rosy tint. I have seen no other British specimens of *rotundifolia* like the Caithness ones. Those from Sutherland (Marshall sp.) and Aberdeen (Trail sp.) are quite typical. Here it will be well to correct an error of mine, *i.e.* *rotundifolia* as growing close to the Caithness border near the Ord (Ann. Scot. Nat. Hist., 1904, p. 232): the specimen is *P. media*! There is another fact with regard to the Caithness examples: the first specimen was gathered on the 2nd of June, the others on the 17th. On 2nd June, in Norfolk, the head of flowers was only short, with the bracts projecting and no sign of a flower. Dickie, in his Guide to Aberdeen, Banff, and Kincardine (1860), gives "July and August." In Iceland in flower on 1st July. Syme (Eng. Botany, ed. 3) says "late summer and autumn." On 16th August 1912, it was still in flower at the Grande Mare, Guernsey. Its habitat is given in our Floras as "Woods and bushy reedy places." "Damp bushy places and reedy

marshes." In Ireland, "Wet bogs." In the United States the Floras all give "Dry woods," and the marsh and bog plant is *P. uliginosa*, Torrey. Yet their summer is far hotter than ours.

P. rotundifolia, Linn., var. *arenaria*, Koch.

In the Hookerian herbarium at Kew there is a sheet of 8 specimens named "var. *bracteata* Hook. & Arn. 1850" (Brit. Fl., ed. 6, 1850, p. 276). They are slender specimens with about 4 flowers on each, and with 7 to 13 bracts on the stem, and the leaves about half the size of the usual Lancashire specimens, probably gathered in a season when the "slacks" were drier than usual. In Linnaea, xxviii (1856), Dr. Alefeld has a long paper on the genus, splitting it up into genera, naming this variety "*Thelaia intermedia*."

The synonymy of *arenaria* is rather extensive:—

var. *arenaria*, Koch, in Syn. Fl. Germ. et Helv., ed. i (1837), p. 478.

P. maritima, Kenyon in Phyt., ii (1847), p. 727.

P. serotina, Melicocq in Ann. Pas-de-Calais (1848–9), p. 223.

var. *serotina*, Melicocq in Bull. Soc. Bot. Fr., i (1854), p. 162.

var. *squamosa*, Hook. in herb. ex Alefeld.

P. arenaria, Dum. Bouq. litt. Belge (1869), p. 41.

f. serotina, Junge, in Verh. Naturw. Ver. Hamburg, xvii (1909), p. 34.

f. pyramidalis, H. Andres, in Mitt. Bay. Bot. Ges., ii (1911), p. 339.

In the Phytologist (1853), p. 1119, Professor D. Oliver gives a translation of a paper by Planchon from the Ann. des Sciences on the above, and mentions that "Sir W. J. Hooker received from some correspondent a *Pyrola* gathered on the Yorkshire coast, and since found on the shores of Lancashire by Kenyon." On this Mr. J. G. Baker remarked in litt.: "*P. rotundifolia* grows in Castle Eden Dene, which Sir W. J. Hooker erroneously supposed to be in Yorkshire —but it is in Durham." The Castle Eden plant has the lower bracts large, etc., like the Southfleet plant. I have not seen any specimen from the adjacent station "on the coast near Hordean Hill," and wish someone would look it

up again. This seems to be the plant that Babington refers to (Journal of Life, 1897, p. 298), in a letter to Professor J. H. Balfour as received by him in 1846, gathered by Brand (1807–1869), as he writes: "You have sent me a puzzle; is it indeed from Yorkshire?" Babington referred it to Kenyon's *maritima*.

Alefeld says his plant is described from 2 specimens of Karelin and Kiriloff (Enum. pl. Soong., No. 539, 1841), 2 of v. *albiflora* in herb. Hooker, 8 from Scotland in herb. Hooker (evidently an error for the Lancashire sheet), and 3 from Vallais. Nyman separates *arenaria* from *maritima*, giving "Scotland" for the first, evidently from Alefeld, and "Angl., Belg." for the latter. But I do not think there is any real difference between the specimens from the Isles of Borkum and Nordeney and the Lancashire ones. And Dumortier (Bouq. litt. Belg., 1869, p. 41) identifies the Belgian plant with Koch's *arenaria*. The earliest Lytham specimens I know of are in the York. Phil. Soc. Herbarium, "S. Hailstone, 1800."

P. media, Swartz.

This occurs in Caithness. On the Wick river at intervals! Reisgill Burn, Thurso river above Giese. Lybster Burn! Side of Ben-a-chielt, *c.* 942 feet! Scorriclett!

In his Prod. Fl. Brit., part 8 (1911), p. 471, Dr. Williams says, "from Wyre Forest, Worcestershire, northward to the Shetland Isles." But its southern limit is Sussex, whence I have specimens gathered by my late friend Mr. Beeby.

This seems to vary little.

P. minor, Linn., var. *arenaria*, Lant.-Beninga, Beit. Kenn. Fl. Ost-frieslands (1849), p. 40.

Ardeer Sandhills, Ayr. Mr. J. Smith sp.

"The spot is now threatened by the extension of a dynamite factory." Williams, Prod. Fl. Brit. (1911), p. 472.

P. secunda, Linn.

"var. *dispersiflora* racemo floribus dispersis vel subdispersis (non secundus), quae varietas primo sat insignis videtur, sed transitus non desunt." Norman, Loco. Nat. spec. in Arct. Norweg. (1864), p. 26.

Although all floras say of the type "raceme secund," this var. can hardly be more than a form. I have seen no British specimens that answer to this.

I believe that the species of this genus are semi-parasitic, see Vuyck, Die Plant. der Dunien (1898), p. 189, and MacMillan, Minnesota Plant Life (1899), p. 89.

The following additions to the distribution have accrued since Supp. to Top. Botany:—

P. rotundifolia.

80. Roxburgh, Sec. Rep. Bot. E. Club, 273, 1916.*

P. media.

40. Salop; Phillips, 1899. 102. Ebudes south, Somerville.

P. minor.

81. Berwick; Ann. Scot. Nat. Hist., 99, 1907. 101. Cantire; *ibid.*, 172, 1906.

P. secunda.

41. Glamorgan; Carr. sp. 42. Brecon; Knight sp. 69. Westmoreland; Baker in N. Yorkshire. 80. Roxburgh; Edinb. herb., 1837. 83. Edinburgh; *ibid.*, Parnell. 85. Fife; W. Arnot, 1839, Herb. Edinb. 102. Ebudes south, Somerville!

In the Supp. to Top. Botany 57, "112. Shetland" under *P. rotundifolia* is an error, the reference there is to Orkney.

It is possible that some day *P. chlorantha*, Swartz, may be found in Scotland: it has broad, short calyx segments and anther pores like *P. uniflora*. Its European distribution is not against its occurrence with us.

Vaccinium Myrtillus, Linn., var. pygmaeus, Ostenfeld, f. microphylla, Lange, in litt. to Beeby.

By Arthur Bennett, A.L.S.

(Read 10th December 1920.)

This very small forma was gathered by the late Mr. A. Somerville on Ben Bharrain (2345 feet alt.), Isle of Arran, 8th August 1904. It was recorded from Saxa Vord

* See also Trail in Trans. Bot. Soc. Edin., xxii (1903), p. 296.

Hill, Unst, Shetland, by the late Mr. Beeby, in the Scottish Naturalist, new series, iii (1887), p. 27. It is only 2·50 cm. high, with leaves 5 mm. × 3 mm. As Mr. Beeby notes, it quite simulates the growth and aspect of *Salix herbacea*, Linn. Even on Glywdr-Fawr, Snowdon, at 3270 feet, *V. Myrtillus* is 14 cm. high, and on Glywdr-Fach at 3250 feet it is 15 cm. high; both gathered by the late Mr. C. B. Clarke! In the Faroes it occurs amongst moss on the highest plateaus of the low hills (Ostenfeld in Botany of the Faroes (1901), p. 57, and fig. 23*a*; Bot. Tidssk., xx (1896), p. 150, and fig. 2*a*). Mr. Beeby gathered an analogous form of *V. uliginosum* on Saxa Vord Hill with leaves 7 mm. × 4 mm., that differs much from an Orkney one (Birsay, J. Spence sp.), which has leaves 13 mm. × 12 mm. (f. *rotundata*), the typical Orkney plant having them 17 mm. × 8 mm.

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

VOLUME XXVIII.

PART III.

SESSION 1921-22.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY BY
NEILL & CO., LIMITED.

And to be obtained from the SECRETARY OF THE SOCIETY, *at the Royal Botanic Garden.*

1922.

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TRANSACTIONS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXVI

Presidential Address—Agricultural Botany in the Past Fifty Years. By W. G. Smith, B.Sc., Ph D.

(Read 20th October 1921.)

A presidential address is an opportunity to look around and survey some branch of knowledge. From time to time this has been done by predecessors in this chair. It is like looking over a countryside from a high view-point —one can observe the lie of the land, neglecting minor details. To deal with the whole field of botany is too large a task, hence I propose to limit myself to things that in my opinion have helped to establish what is called agricultural botany. A further limitation to a fifty-year period, back to about 1870, seems justifiable, as it avoids groping through a somewhat scanty period of literature that marks the evolution of order out of chaos. About fifty years ago an agricultural botanist was defined as someone who knew a little of agriculture, and less of botany. That does not hold good now, for many of the more recent problems concerned with soil science, plant nutrition, heredity, and pathology require a thorough knowledge of the latest researches in botany, and a good deal of cross-reference to chemistry, zoology, and bacteriology, even to higher mathematics in calculations referring to heredity and the probable error in field experiments.

Crop Plants.—No new cereals have been introduced

since 1870. Wheat, barley, and oats still occupy the cornfields, increasing or decreasing according to demand and price. The tendency has been for grassland to replace cornland, and the increase of corn fostered during the years of war is already disappearing. Rye, the important crop of middle Europe, has made some progress in certain districts. There have been great changes in the varieties of cereals, so that very few of those widely grown in 1870 are on the market now. To introduce an old variety under a new name is not unknown, but as regards cereals there has been a real change into new types with a higher production or otherwise better for the farmer. The search for new varieties was never more active than at present. The potato was an established crop-plant fifty years ago. Gerard described it about 1596, and predicted a great future, but in 1700 it was still a despised plant "fit to be grown in the worst part of the garden" (Evelyn). After 1750 the cultivation of potatoes rapidly increased, and by 1850 Lawson had described and prepared models of numerous varieties.[1] From 1845 to 1875 growers were much discouraged by the ravages of potato blight, but the past fifty years have seen considerable progress in means for checking that disease. Since 1870 the names of potatoes have changed again and again, old varieties have been replaced by new, and the present time is a period of speculative activity when new varieties appear every year, claiming to be immune from "wart" disease. In this connection it is noteworthy how the departments of agriculture have quickly tackled this serious disease, so that its ravages have never reached the disastrous "blight years" about 1870. Flax and sugar-beet are crops that can be grown in Scotland, and their neglect as crop-plants may look like indifference. It is, however, mainly a problem of supply and demand. Both crops entail much labour for the grower, and the produce requires to be manufactured. The factory depends on the grower, and the grower on the factory; and if the latter cannot repay the farmer, then he cannot grow the crops.

The past fifty years have brought a great change in the

[1] A collection of Lawson's models is now in the Edinburgh and East of Scotland College of Agriculture.

laying down of grassland. An early method was to grow corn till the land was foul, then it was left to become a grassland of some sort. Another method was to sow the sweepings of the hay-loft. Later came the practice of sowing rye grass and clover seeds, and this was almost universal fifty years ago. About 1870 "natural grasses" were much discussed, but it was only the pioneer who ventured to use them. Now every farmer knows something of cocksfoot, timothy, and other grasses, and many are experimenting actively to obtain the most productive grassland for their farms. In recent years great results have been obtained by using "wild" white clover, and there are indications that the red clover seed now in use will be replaced by better strains of "wild" red clover.

Nutrition of Plants.—During the seventeenth century Van Helmont, Priestley, and others founded this branch of botany, but even in the early part of last century there was no clear view how a plant obtained its food supplies. About 1840 the forceful Liebig and his pupils established the "mineral" theory of plant nutrition, and this was eagerly adopted by agricultural science, so that nitrogen, phosphates, potash, and calcium became part of the ordinary talk of the market-place. A result of this period was a worship of the chemical analysis and a serious neglect of the living plant. There is still a remnant of this sentiment, but one of the greatest advances of the past fifty years has been the recognition that the living plant is not understood when it has received a name. Our period has seen a marked extension in the accommodation for botanical teaching and study in almost every university, including the Scottish ones. Much of this development has been in the direction of plant physiology. The publication of Sach's lectures in 1865 brought order out of chaos, and the textbook "Physiology of Plants," by Vines in 1886, first revealed to English readers this important new domain of botany. There can be no doubt that experimental physiology has been of great importance in the successful growing of crop plants.

Soil Biology.—Another great development is the recognition that not only is there life in the plant, but there is life in the soil. About 1870 Pasteur suggested that the

formation of nitrates and ammonia from farmyard manure is not a simple chemical process, as Liebig taught, but that it is due to bacterial action. The chain of evidence has been forged link by link, so that now we recognise that the soil contains innumerable minute organisms (bacteria, etc.) all actively changing the soil, either improving its fertility or diminishing it. The soil is like the plate of nutrient jelly of the bacteriologist, the important part is the food for the living organisms. The mineral particles, sand and clay, are mainly a skeleton to carry the jelly or colloid, and to control the supply of air and water. The word colloid was first used by Graham in 1861 in his studies of liquid diffusion. Colloids have great powers of absorption, hence excess of colloid, as in a peaty soil, leads to a poor crop (*e.g.* heather), whereas the proper colloidal state assists fertility. The utility of soil micro-organisms was demonstrated in one direction by the experimental work on the root-nodules of Leguminosae, chiefly that of Hellriegel and Willfarth described in 1885. Another step was the recognition of nitrification, the formation of nitrates by soil bacteria. This was first suggested by Warington at Rothamsted in 1879, and since then his views have been confirmed that the nitrogen of organic matter is made available for green plants by the activity of soil micro-organisms. The pioneer work on mycorhiza (fungus-roots) on trees by Muller in Denmark, about 1878, opened another aspect of plant nutrition. This has been extended, so that now a number of species are known to supplement their food supply with the assistance of fungi in the soil.

Apart from symbiotic organisms, there is evidence that the plant bears a relationship to the soil that cannot be expressed in terms of abundant or deficient nitrogen, phosphate, etc. When plants are grown under close observation, great differences are known to exist: one soil is fertile, another is infertile. This problem has not yet been solved, and it is too early to say yet which of the methods now being tested, if any, will form the test of soil-fertility.

Plant Breeding.—Rather more than fifty years ago Darwin's "Origin of Species" brought together numerous

records and opened the way for an important development. Plant breeding of crop-plants was carried on by Vilmorin about 1850, and later by others like Garton, but in these commercial enterprises it was not to be expected that the actual methods would be adequately disclosed. About 1870 Denmark became the leader in State organisation of agricultural research, and the example has been followed by other countries. Sweden in 1886 established a seed association in connection with the plant-breeding work at the experimental farm at Svälof, and at the present time two of the more productive oats in Scotland—Victory and Crown—are varieties obtained at Svälof within the present century. Plant breeding in Ireland during the same twenty years has entirely changed the varieties of barley grown there. Similar work by State departments in Canada and the United States has greatly increased the yield and value of wheat and oats in North America.

Two chief methods are used in plant breeding: selection or the search for new varieties as variations or mutations from existing races; hybridisation to combine the characters of parents, followed by selection of the more useful progeny. Neither of the methods is new. Pliny (23–79 A.D.) describes cabbage, tall and dwarf kale, kale-sprouts, and kohl-rabi, all varieties obtained by continuous selection from the wild cabbage. In 1597 Gerard illustrated red and white cabbages, brussels sprouts, and cauliflower, in all fifteen varieties. Numerous varieties of farm and garden crops were described by Lawson of Edinburgh in 1850, mostly the produce of selection. Now plant improvement by selection can be carried out more rapidly and with fewer mistakes. Hybridisation has, however, made very distinct progress in the last twenty years. Kohlreuter (1760–1766) established the importance of insects and wind as agents in cross-pollination. Thomas Andrew Knight in 1779 published his results in crossing peas and various fruit trees. Other landmarks are Gaertner's book in 1849 and Naudin's Essays in 1862. Charles Darwin, in gathering material for his "Origin of Species" (1858) brought together much information on plant breeding by hybridisation and by selection. About 1860 it is evident that much was known, but the knowledge

was vague and the principles were little understood. The whole subject assumed new interest after Gregor Mendel's experimental work. Mendel (1822–1884) made experiments mainly on peas, and published his results in 1865, but the paper was overlooked till 1900, when translations appeared in several countries. Numerous investigators made new experiments, and the past twenty years will always stand out as a historical period in hybridisation. It is too optimistic to assume that Mendel's Laws have solved all the difficulties, but it is safe to say that they mark a great stride. As a result, it is possible to raise new varieties of crop-plants within a few years. If one variety has high yielding powers and another variety has, say, hardiness, these can be combined by methods which are now fairly well understood. Thus the leading barley in the Lothians, "Plumage Archer," is a cross made in 1905. Biffen's crossings of wheat since 1900 have yielded varieties with superior baking qualities, and others that are resistant to wheat rust.

Pathology.—The study of disease in plants has made great progress. Previous to 1870 much had been done in identifying fungi, insects, and other parasites on plants, but far more attention was given to the fungus or other organism than to the plant affected. In the early nineteenth century Link was doubtful whether the spores of fungi could germinate. Persoon in 1818, while admitting that some fungi arose from spores, resorted to spontaneous generation to explain the origin of others. The real awakening came from France, when the brothers Tulasne, between 1850 and 1865, worked out the life-history of rusts and smuts, of ergot, and the sexual organs of Peronospora. The newer school of plant pathologists owe much to De Bary and Brefeld and their pupils, so that the present era of accurate laboratory methods, pure cultures, and inoculation had their origin since 1870. It was not, however, till about twenty years ago that our universities extended facilities for teaching and research in plant pathology, and the stimulus came mainly from the agricultural schools. The recognition of the value of colonial crop-plants has given great opportunities to many of our home-trained mycologists, so that within recent years a

huge literature has been created on the diseases of rubber, tea, coffee, sugar-cane, cotton, etc.

The treatment of plant diseases may be described as a collection of scraps of experience, up till the early part of the nineteenth century. Sulphur as a fungicide for peach mildew was known in 1821, and the combination of lime and sulphur used in 1851 was the beginning of the lime-sulphur fungicide so much in use now. The use of copper sulphate against fungi may have been known earlier, but it was Millardet of Bordeaux who, about 1885, realised the merits of a combination of copper and lime in the well-known "Bordeaux mixture." Formalin does not appear in books as a fungicide till after 1896.

Our knowledge of plant hygiene or how to keep plants healthy is still mainly empirical. A promising beginning has been made with "immune varieties." The results obtained in France, about 1890, through using vines of American origin, by grafting or by hybridisation, attracted attention. Eriksson in Sweden, MacAlpine and others in Australia, and Biffen at Cambridge have attained good results with varieties of wheat immune to rust. In more recent times the success of varieties of potatoes immune to wart disease has saved this country millions sterling. The discovery of immune varieties is an important branch of plant breeding which, combined with modern methods of mycology, render it probable that the future will combat plant disease by preventing it.

This brief survey may suffice to emphasise that the progress of applied botany depends on the utilisation of the latest researches of botany as a whole. Conversely, that the stimulus to further investigation in botany may come from the problems incidental to agriculture, forestry, and horticulture. Taxonomy or systematic botany has raised men skilled in detecting the differences in varieties so essential in plant breeding. Plant physiology with its laboratory equipment has placed the understanding of plant nutrition and plant response on a firm basis. Ecology, in its endeavours to ascertain the relation of plant to soil and climate by a study of the native plants, has led to a better concept of the utilisation of land for economic purposes. Mycology is saving millions sterling of crops

that might have been destroyed by fungus pests. The linkage of so-called "practice and theory" should be self-evident, if there ever was any doubt about it. The past fifty years have seen ever-increasing specialisation in the various branches of botany, almost a separation of the schools. Yet the same period has seen the evolution of agricultural botany and other collateral branches of the parent botany, where the purpose is to join together link by link the facts bearing on the problems peculiar to the economic need.

Note on a Seedling of Cytisus Adami.

By T. Bennet Clark, C.A.

(Read 17th November 1921.)

I should explain that I have come to submit this note on a seedling of *Cytisus Adami* as the outcome of my having attended, at the recent Edinburgh meeting of the British Association, an interesting lecture by Professor Weiss upon "Graft Hybrids," a subject which has for a long time interested botanical students, and as to which I believe there is still a great deal to be discovered.

The pink-flowered Laburnum, *C. Adami*, is a graft hybrid, and propagation is secured by grafting the hybrid on Laburnum stock — the common yellow-flowered Laburnum or one of its varieties,—and in this way nurserymen maintain their supply of the shrub.

I might perhaps refer to the history of *C. Adami*. In 1825 a gardener called Adam, who was interested in grafting and budding, had budded on a yellow Laburnum a shield or bud of the well-known *Cytisus purpureus*, a low-growing and rather spreading shrub with purple flowers in the axils of the leaves of the young wood—the plant being rather a subject for the rock garden than for the shrubbery. I have been told that it had been the custom to graft or to bud this plant on a Laburnum stem as a standard, and the *C. purpureus* grew and flowered at the top much like a Standard Rose. But this particular bud of Mr. Adam's "did not take," as a gardener would

say, and on the Laburnum stem near where the bud had failed there appeared a strong shoot which bore narrow leaves distinctly different from the leaves of the Laburnum stock and resembling the smaller and narrower leaves of *C. purpureus*. This shoot was allowed to grow, and eventually it bore flowers in racemes of a dull pink colour. Grafts from this strange development were made on other Laburnum stocks, and these as they developed preserved the habit and flowers of the original "Graft Hybrid."

Not uncommonly some of the branches of this graft hybrid revert to the original forms from which the hybrid is supposed to be derived, and so there comes about the curious development of the same tree bearing three kinds of flowers and foliage. This peculiarity had developed on Mr. Adam's original budded tree, a development which is maintained in most of the trees raised from *C. Adami* by grafting.

Some fifteen or twenty years ago, when I was planting a few flowering shrubs I included among them the pink Laburnum, *C. Adami*. It was then all pink flowered, but a few years later it showed the yellow-flowered branches, the original Laburnum of the stock breaking out, and it has now broken out very largely in spite of much pruning. Only in the last year or two are there small pieces of the purple Cytisus appearing on my tree, but not to any extent.

This is all preliminary, and I come back to Professor Weiss's most interesting lecture. When dealing with *C. Adami* he explained, what I had already found out, that the pink racemes are almost invariably barren, none of the seed pods filling up. He further explained that when the seed of the yellow-flowered portions are planted the resulting trees are always just the yellow Laburnum, and in fact all seedlings from *C. Adami* that have so far been recorded are of the pure yellow type.

Having failed to find any seed of the pink flowers, which I frequently looked for, I thought I would try to see what was produced from a handful of well-filled pods from the yellow portion of my *C. Adami*. I think about forty seeds were sown, and I was rather pleased to find that one of the seedlings had the smaller and narrower and the somewhat darker leaves of the pink-flowered part of

the parent. After keeping this seedling tree for some years under observation, I found, to my regret at the time, that it produced rather short yellow-flowered racemes, and not the pink ones as I had hoped. But I was much interested to note that as the tree grew it always preserved the peculiarity of these narrow leaves, and, to a very large extent, the habit of the pink parent, or rather of the pink-flowered part of the parent. I then relegated the tree to the border of a planting at Newmills. I had kept about a dozen of the other seedlings to see if anything should happen among them, but they are all ordinary Laburnums.

When I heard Professor Weiss's record of information as to the result of sowing seed such as I had sown, I interviewed him after his lecture and told him all about my tree. Later I provided him with specimens, and of what he has called "this very remarkable plant" he intends to make a careful examination. He also writes, "I must say I have not seen any more interesting specimen in connection with *C. Adami* than the seedling with the foliage of the purple hybrid."

I have now made a careful examination of my seedling tree to see if the flowers had set, and, as it was rather late in the season, I found only one seed pod containing three apparently fully matured and healthy seeds. I shall see what these may produce in due course. I cannot undertake to give any opinion as to why one of the forty seeds should have produced this tree of very distinct habit and foliage from all the other seedlings of the same gathering —a habit distinct from Laburnums generally, which it has shown and kept from the time it started. Further, I may say that although my seedling tree has not yet produced any pink racemes, I am not without hope that it may do so. At all events I am assured that my tree is a "new departure," and for that reason I have thought it was of sufficient interest to submit this note to the Society.

Salicornia dolichostachya, Moss, in Scotland. By E. J. Salisbury, D.Sc., F.L.S.

(Read 17th November 1921.)

Up to the present no record of *Salicornia dolichostachya*, Moss, has been made for Scotland, although the species occurs in Denmark. When visiting the salt marsh near Gullane, however, with Section K of the British Association (September 1921) this species was found by the writer growing in its normal habitat, namely, near the seaward limit of the salt marsh. In the higher parts *Salicornia herbacea* occurred in some quantity, both the *forma stricta* and the *forma patula* being present, though the first named was by far the more abundant.

The plants of *Salicornia dolichostachya* were quite typical, exhibiting the long, blunt, tapering spikes in which the lateral flowers are almost or completely separated by the central one. In one specimen a very rare and interesting abnormality occurred, the partial dichasium consisting of four in place of three flowers. The supernumerary flower was central in position, so that two superposed flowers completely separated the lateral ones. In several specimens the accessory spikes, which are so characteristic of this species, were present. They arise from below and at the base of the sterile segments of the main lateral spikes.

As might be expected from the presence of both *S. herbacea* and *S. dolichostachya*, a few intermediates occurred, which probably represented hybrid offspring, and in which the central flower did not separate the lateral ones.

Notes on Pinguicula. By Arthur Bennett, A.L.S.

(Read 17th November 1921.)

Pinguicula alpina, L.

In the Secretary's Report of the Bot. Soc. and Exc. Club for 1919, p. 671, he remarks that this species is "now extinct at Avoch, E. Ross, owing to seedling conifers

drying the bog in which it formerly grew. No actual habitat now known." This seems to ignore the W. Sutherland station recorded in Journ. Bot. (1885), p. 311.

The place of growth in E. Ross has been described in various ways and under various names. The record in English Botany, Suppl. 2747 (1832), is not correct. The first record is given by Dr. Murray in his Northern Flora (1836), p. 17, as follows:—"Mr. G. Campbell Smith, Land-surveyor at Banff, . . . first observed *Pinguicula alpina*, in June 1831, upon Rosehaugh property (part of the Black Isle of Ross, lying between the Friths of Beauly and Cromarty), which he was then surveying for Sir James W. Mackenzie." Murray further remarks (p. 17) that "Mr. Smith communicated his specimens to Mr. Gordon, Minister of Birnie, who visited the quarter mentioned during the same summer; and, subsequently, other discerning botanists had an opportunity of inspecting the plants, gathered either by Mr. Gordon or Mr. Smith, but these not being closely examined were merely regarded as *P. lusitanica* from a new and remarkable habitat. The credit of ascertaining this to be a new Pinguicula is due to Mr. H. C. Watson, who decided it to be *P. alpina* of Linnaeus."

Other records are:—"Near Loch Avoch" (G. Gordon); "Raddery Moss in Rosemarkie parish" (Dr. Nicholson); "Bogs of Auchterflow and Shannon on the Rosehaugh property" (G. Gordon); "Munlochy Bay and Invergordon in the Black Isle" (Anderson's Guide).

In Watson's herbarium at Kew are specimens labelled "Strath of Auchterflow, parish of Avoch, along with *Thalictrum alpinum*, on a moor surrounded by cornfields behind Rosehaugh House" (W. A. Stables, 1843); "Marsh on the Millbuie Ridge" (W. A. Stables, 1845).

In Watson's Outlines of the Distribution of British Plants (1832), p. 234, the following note is given under *P. alpina*:—"In a sheet of *P. lusitanica* in Sir J. E. Smith's herbarium is one marked by Sir J. E. Smith 'Isle of Skye, 1794—Mr. J. Mackay,' which is certainly *P. alpina*. Mr. David Don told me that he well remembers his father finding a Pinguicula in Aberdeenshire or Angus which he considered *P. alpina*, but it does not appear that he pre-

served specimens"—*W. Christy*. In Hooker's Brit. Flora, ed. 3 (1835), p. 10, there is the following footnote:—"Dr. Graham says, 'I understand there are two specimens in the herbarium of Sir J. E. Smith upon the same paper with *P. lusitanica*; marked as sent by Mr. James Mackay, in September 1794, from the Isle of Skye.'"

Dr. Williams in Prod. Fl. Brit. (1909), p. 351, remarks: "I have examined these two specimens in Sir J. E. Smith's herbarium at Burlington House. They seem to me rightly placed in *P. lusitanica*, and they certainly do not match a specimen of *P. alpina* from Swartz on the next sheet."

Mr. J. T. Johnstone of the Edinburgh Botanical Society informs me that the latest specimens they have knowledge of from the Black Isle are dated 1863, and I have specimens gathered in that year by Mr. G. N. Stables. Mrs. Wedgewood and Mr. C. E. Salmon visited the Ross station (enclosure behind Rosehaugh House) in 1916. The innkeeper told Mrs. Wedgewood that the plant had gradually disappeared. In the spring of that year only two or three weak plants had come up and had withered away very soon. The enclosure is now grown over by *Calluna* and *Erica Tetralix* and planted with conifers. *Pinguicula alpina* thus seems to have disappeared from the Black Isle, where it has been known to exist since 1831.

In the north of Europe the species is rare in Sweden, in Gotland, and in S. Lapland. It occurs in five provinces of Russian Lapland and two of Finnish Lapland; N. Norway: Faroes (?) (not given by Ostenfeld); Iceland (?), Stefansson's Flora Islands does not name it.

P. GRANDIFLORA, Lam.

In the Trans. Bot. Soc. Edin., xxiii (1908), p. 251, Canon Spence Ross states that the above species occurs in the Black Isle near Fortrose and Ferintosh by Dingwall. But are these specimens not large-flowered *P. vulgaris*?

P. grandiflora, regarded as a native in Cork and Kerry, has established itself in Cornwall, where, according to Davey, Fl. Cornw. (1919), p. 345, it occurs abundantly, having spread from plants originally planted by Dr. Ralfs on Tremethick Moor.

P. LUSITANICA, L.

Babington in the first edition of his Manual (1843), p. 239, remarks: "*P. villosa*, distinguished from this (*lusitanica*) by its acute spur and obconical capsule, may be expected in the north of Scotland." The distribution of *P. lusitanica* in Europe is very limited—Portugal, Spain, and France, west and north. Usually a lowland species, it occurs in Ireland on the Mourne Mountains at 1560 feet. It is found in 31 of the 40 divisions employed by Mr. Praeger (Irish Top. Bot., 1901) and exhibits a curious distribution, being absent from the centre of Ireland as shown by the map given by Praeger in Proc. Roy. Irish Acad., xxiv, B. (1902), p. 38. The plant is included among those which show a "Marginal Type" of distribution in Ireland. The species occurs at Dunkirk in France about 51° N., its most northern locality in Europe, except the British Isles, where it extends north to Orkney, occurring at 58° 58′ N. lat.

I do not find that the hibernacula in this genus are often referred to. Hopkirk in Flora Glottiana (1813), p. 10, mentions the little green balls, and they are mentioned by Withering, British Plants, ed. 7, ii, p. 23 (1830). I have examples on fruiting plants of *P. lusitanica* from near Loch Naver, W. Sutherland (E. S. Marshall, 2, ix, 1887), and on the same species from Ophir, Mainland, Orkney (W. A. Fortescue, September 1911), and on *P. vulgaris* from Islay (A. Somerville). In Leighton's Flora of Shropshire (1841), p. 11, he remarks: "On the gradual decay of the leaves in autumn, small, round, leafy buds or hybernacula are formed, which survive the winter and are capable of developing new plants in the spring."

Formania: a new Genus of the Compositae from Yunnan. By Professor Wright Smith, M.A., and Professor James Small, D.Sc. (With Pl. II.)

(Read 13th January 1922.)

Formania, W. W. Sm. et J. Small. Genus nov. Compositarum.

Genus Anthemidearum; prope Chrysanthemum allocatum; paleis pappi longis linearibus ad *Cancriniam* propinquat atque aliquatenus haud procul ab *Allardia*; a generibus illis habitu erecto fruticoso recedit et receptaculo fimbrillifero differt; a *Chrysanthemo* pappo anomalo et antheris acutis sagittatis divergit.

Fruticulus ad 1 m. altus erectus ramosus. Rami graciles cortice cinerascente induti, juniores puberuli. Folia alterna nunc ad ramulos breves approximata in petiolum brevem latiusculum saepe vix discretum angustata, 1–1·5 cm. longa, 5–10 mm. lata, ambitu obovata, textura crasse papyracea, ad medium vel ultro pinnato-incisa, lobis 5-9 triangularibus vel nunc subquadratis saepe ipsis incisulis lobulis apiculatis, utrinque glabra. Capitula 3–12, heterogama, corymbiter disposita, ramos terminantia, cylindrica, circ. 7 mm. longa, pedunculis puberulis ultimis 1–10 mm. longis nudis vel foliis multo reductis instructis. Involucri phylla pluriseriata exteriora breviora, interiora longiora, ad 5 mm. longa, circ. 1–1·5 mm. lata, oblonga vel lineari-oblonga, obtusa vel subobtusa, scariosa, medio pallido-viridia, supra albo-ciliolata. Receptaculum planum fimbrilliferum. Flores ligulati ♀, circ. 10 pallido-flavi; pars tubulosa circ. 3 mm. longa; ligulae 3 mm. longae; rami stylares latiusculi apice rotundati v. sub-truncati; achaenia 2 mm. longa; pappi paleae quinque lineares 3 mm. longae brevioribus 10–12 additis; flores disci ☿ circ. 8, cum achaenio puberulo circ. 1·1 cm. longi; antherae basi auriculis brevibus acutis sagittatae; styli truncati. Fructus maturi desunt.

Genus monotypicum chinense provinciae yunnanensis incola.

Formania mekongensis, W. W. Sm. et J. Small. Gen. et sp. nov.

"West China:—Bei Ma Shan, Mekong-Yangtze divide, Yunnan, in open situations amongst scrub. Lat. 28° 20′ N. Alt. 10,000 ft. Aromatic shrub of 2–3 feet. Flowers pale yellow. August 1914." G. Forrest. No. 13,183.

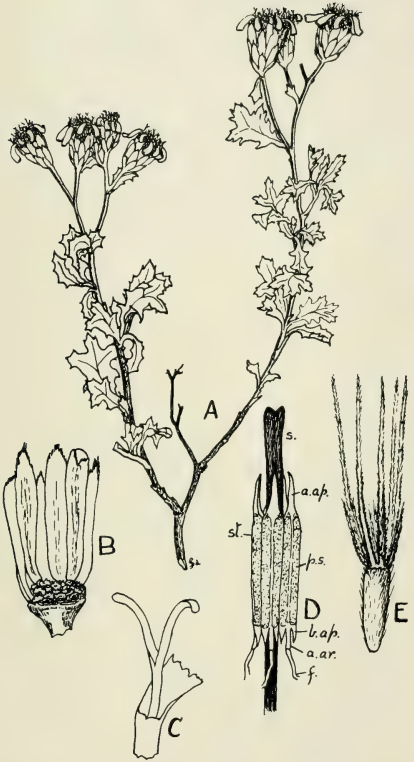
This interesting plant is one of the many new types discovered in Yunnan by Mr. G. Forrest. The fimbrillate receptacle is of interest in connection with the occasional development of quite distinct receptacular paleae in the allied genus, *Chrysanthemum*. In the latter, part of the edge or "fimbrilla" sometimes grows out to form a bract-like structure, in spite of the fact that the absence of receptacular scales is the one diagnostic character of the *Chrysanthemidinae*. The development of the five long paleae of the pappus, very distinctive in *Formania*, might be considered to have occurred in the same way, from some of the numerous short scales which occur on the top of the achenes in some species of *Chrysanthemum*. The presence of well-developed basal appendages to the anthers would even then remain as a floral character separating *Formania* from *Chrysanthemum* and *Cancrina* in which such appendages are absent, and also from *Allardia* where the auricles are connate, not free as in *Formania*.

The generic name which has been attached to the new genus is in honour of the Rev. Adam Forman, O.B.E., one of the chief organisers in Scotland of the supply of *Sphagnum* in the form of surgical dressings during the years 1915–1919.

EXPLANATION OF PLATE II.

Formania mekongensis, W. W. Sm. and J. Small.

A. Portion of flowering branch (nat. size).
B. Fimbrillate receptacle with a few involucral bracts attached.
C. Portion of ligulate floret showing bifid style.
D. Dissection of style, *s.*, and stamens, *st.*, of disc floret, showing truncate style and parts of stamens as follows:—*a. ap.*, apical appendage; *p. s.*, pollen sac; *b. ap.*, basal appendage; *a. ar.*, article anthérifère; *f.*, filament.
E. Achene of disc floret showing ciliate paleaceous awns or scales of pappus.



Formania mekongensis, W. W. Sm. et J. Small.

Parasenecio: a new Genus of the Compositae from China. By Professor Wright Smith, M.A., and Professor James Small, D.Sc. (With Pl. III.)

(Read 22nd January 1920.)

Parasenecio, W. W. Sm. et J. Small. Genus nov. Compositarum.

Genus *Senecioidearum*; *Senecioni*, Linn. affine a quo appendicibus antherarum magnis obtusis, ramis stylorum penicillis longis ad apicem praeditis, corollae colore, phyllis involucri paucis sub anthesi apice plus minusve cohaerentibus differt, habitum specierum *Ainsliaeae*, DC. nonnullarum simulat.

Herba perennis; rhizoma gracile lignosum strigosum. Caules solitarii erecti herbacei circ. 10-costati apice pubescentes, basi dense pilosi, paniculas laxas pauciramosas gerentes. Folium radicale solitarium magnum cordatum petiolatum marmoratum tenuiter membranaceum, margine ciliatum, crenaturis apiculatis notatum, supra pilis longis adspersum, infra ad nervos nervulosque prominentes dense vestitum; folia caulina plerumque solitaria, raro duo, radicali multoties minora, ceteroquin subsimilia. Capitula mediocria homogama campanulata nutantia floribus 10–15. Involucri phylla 6–8 subbiseriata, interiora 3–4 latiora, exteriora 3–4 angustiora, omnia sub anthesi apice cohaerentia, tandem soluta, lanceolata vel lineari-lanceolata, pilis brevibus adspersa. Receptaculum parvum foveolatum. Corolla pallide rosea fere alba, regularis, tubuloso-campanulata, alte 5-loba. Antherae basi appendiculatae, auriculis magnis obtusis mucronatis. Styli bifidi illos *Senecionis* simulantes sed ad apicum latera longius penicillata. Achaenia 5 mm. longa teretia 5-costata glabra. Pappi setae numerosae albidae molliter scabridae.

Genus monotypicum montium provinciae chinensis Szechwan incola.

Parasenecio Forrestii, W. W. Sm. et J. Small. Gen. et sp. nov.

"West China: Mu-li mountains, S.W. Szechwan, in open, dry sandy pasture. Lat. 28° 12′ N. Alt. 12,000 feet.

Plant of 18–20 inches. Flowers nodding, pale rose, almost white. August 1918." G. Forrest. No. 16,788.

Also in fruit, October 1918. G. Forrest. No. 17,074.

This interesting plant, with its large marbled leaf and pendulous capitula, is an attractive species of a Gesneroid appearance (Pl. III. fig. 1). Although quite unlike in general appearance, *Parasenecio* shows several affinities with the species of *Cremanthodium* of the neighbouring regions, particularly in the large size of the radical leaf and the long, erect flower-stalk with nodding capitula. It approaches some species of the *Ligularia* section of *Senecio* in general habit, but the single radical leaf and many of the characters of the capitulum and florets are quite distinct. Apart from the colour of the corolla all the characters of the plant, except the well-developed obtuse tails of the anthers, would allow of its being placed in the genus *Senecio*. In the section *Synotis* of the Himalayan species of *Senecio* basal appendages to the anthers occur, but these are quite different in size and shape. The long apical hairs of the style-branches and the peculiar adhesion of the tips of all the young involucral leaves combine, however, to make it an unique species, which would be unique even if included in *Senecio*. It is, therefore, deemed more advisable to make a new genus of the plant and thus draw attention to its striking peculiarities rather than to include it amongst the 2500 species of *Senecio* where it would require a position of sectional or sub-generic rank. The generic name given to the plant indicates this point of view and also the affinities of the genus.

The plant is a perennial herb with a thin woody rhizome (fig. 1, A) which throws up one large radical leaf. This solitary leaf (fig. 1, B) has rather an ornamental appearance (in the figure the lower surface is shown); it is cordate, about 6 inches in diameter, very thin, and marbled with pale green in the spaces between the veins (*cf.* fig. 1, C); the margin is ciliate and crenate, the crenations and most furrows being marked by one or more small denticulations. The denticulation at the apex of each crenation is dark purple in colour and seems from an examination of the dried leaf to be a typical hydathode at the end of the vein,

such as occurs in *S. lagopus*, Raoul and *S. saxifragoides*, Hook. f., of New Zealand.[1] The upper surface is sparsely covered with unusually large simple hairs, somewhat similar to the silky hairs of *S. lagopus*. On the lower surface these hairs are aggregated along the main veins and, assuming a brown colour, are very like bryophytic rhizoids. The petiole, which is 1½ to 2 inches long, is also densely covered with these large brown hairs. The ridged flowering stem about 18 or 20 inches high arises later in the season from the axil of the radical leaf. Usually one small leaf, rarely two, very similar, except in the absence of crenations, to the radical leaf occurs about 3 inches from the base of the flowering stems (fig. 1, C); no other foliage leaves are present. About a foot above the cauline leaf the stem branches into a loose, very slightly branched raceme. The capitulum is bracteate, shortly pedicellate and droops (fig. 2). It is pear-shaped when young on account of the cohesion of the involucral leaves, which continues as far as is at present known until the beginning of the anthesis. Fruiting capitula (fig. 3) are campanulate and have the involucral leaves free. These leaves separate from the base upwards but remain attached at the tips until anthesis begins (fig. 2). The involucral bracts are six or eight in number, the three or four linear-lanceolate leaves overlapping at their edges the three or four inner, broader, lanceolate leaves. There are thus two series, an inner and an outer of involucral leaves, but since all six or eight are required to complete the circle around the florets, the involucre is described as sub-biseriate. The bracts are sparsely covered with short hairs, but the outside of the receptacle and the pedicel immediately below are densely hairy. The receptacle is small, flat, and foveolate. Ray florets are absent; all the 10–15 florets are hermaphrodite, regular and tubular campanulate (fig. 4.). The style (fig. 5) is branched; the style branches are flattened with truncate, penicillate tips; the apical hairs at the sides of the tips are much longer than is usual in *Senecio*. The stamens have the typical apical appendages (fig. 6), and very distinct, obtuse,

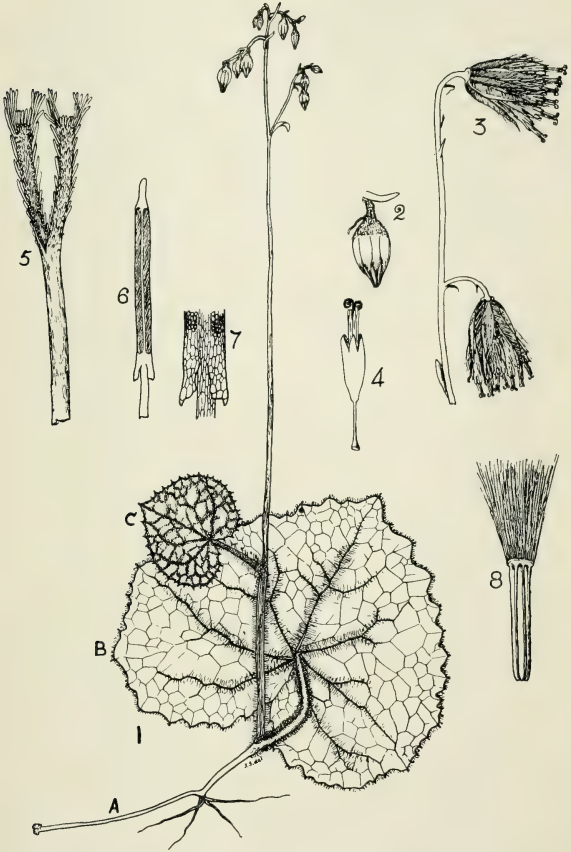
[1] Wall, A.: On the Distribution of *Senecio saxifragoides*, Hook. f. Trans. N. Z. Instit., Vol. l, p. 201, 1917.

mucronate, basal appendages (fig. 7), which are quite unlike the inconspicuous, small, acute appendages of some Himalayan species of *Senecio*, e.g. *S. Candolleanus*, Wall., and *S. chenopodifolius*, DC. The corolla is tubular-campanulate, regularly and deeply 5-lobed (fig. 4); pale rose almost white in colour (*fide* Forrest), drying to a dark brown. The achenes (fig. 8) are terete and glabrous with five prominent ridges. The setae of the pappus are numerous white, soft, and scabrid.

Apart from its interest as a new type of *Compositae*, *Parasenecio* is interesting on account of its bearing upon the evolution of the family. Whereas *Cavea*[1] was suggested to be an ancient type and possibly a remote ancestor of the Cynareae, this new genus seems to be one of the most recent developments from the *Senecio* plexus. The single, large, radical leaf suggest a comparison with *Tussilago* and *Petasites*; the geophilous method of projecting the inflorescence first which obtains in these two genera may be regarded as a secondary adaptation to the short summer season characteristic of the more northern habitats of the coltsfoot and butter-bur. The affinities which are shown with *Cremanthodium* and with the *Ligularia* and *Synotis* sections of *Senecio* have already been mentioned, and in these more immediate neighbours of the new genus we do not find the geophilous habit. *Parasenecio*, therefore, has affinities with the northern, uniphyllous, geophilous type and with the more southern, radical-leaved, scapigerous type. Both these types, according to the views of one of us,[2] were derived from *Senecio* by the response made to various environmental factors. It is noteworthy, therefore, that the elongated appendages of the style branches and the simple stamens which distinguish the *Tussilagininae* and *Ligularia* are absent in *Parasenecio*, which thus approaches the common ancestor of those groups more closely than does any genus of the *Tussilagininae*. *Parasenecio*, in fact, appears as another

[1] Smith, W. W. and Small, J.: *Cavea;* a new Genus of the Compositae from the East Himalaya. Trans. and Proc. Bot. Soc. Edin., Vol. xxvii, p. 123, 1917.

[2] Small, J.: Origin and Development of the Compositae. New Phytologist., Vol. xviii, p. 206, 1919.



Parasenecio Forrestii, W. W. Sm. et J. Small.

offshoot from *Senecio*, which has arisen in the same region but at a much later date as the expression of tendencies in *Senecio* somewhat similar to those which gave the *Tussilagininae*. The difference in the colour of the corolla may well be due to the anthocyan changes, like those which gave the *red* sunflower, the brilliant hues of *Cremanthodium*, and the more subdued tints of *Petasites*; but the development of the long hairs of the style-branches, the well-developed, obtuse basal appendages of the anthers, and the peculiar cohesion of the young involucral bracts all show that *Parasenecio* as an offshoot from *Senecio* makes altogether a new angle with the parental stem.

EXPLANATION OF PLATE III.

Fig. 1. General habit of *Parasenecio Forrestii* under surface of radical leaf and upper marbled surface of cauline leaf shown.
Fig. 2. Young capitulum showing slit-openings of involucre.
Fig. 3. Fruiting capitula showing mature shape and free involucral leaves.
Fig. 4. Floret of same showing exserted anther-tube and recurved style-branches.
Fig. 5. Style showing long apical hairs.
Fig. 6. Stamen showing apical and basal appendages.
Fig. 7. Lower part of same showing obtuse mucronate basal appendages.
Fig. 8. Ripe achene showing pappus and ridges.

Alchemilla conjuncta, Bab., in Dumfriesshire.

By G. F. Scott Elliot, M.A., B.Sc.

(Read 10th February 1922.)

During the summer of 1921 a specimen of what appeared to be this species was forwarded to me by Mr. Gladstone, Younger, of Capenoch. He and Mr. Scott, Thornhill, had found it growing in a certain glen near Penpont at a considerable distance from any cottage.

The name *A. conjuncta*, Bab., was confirmed by Mr. W. E. Evans of the Royal Botanic Garden, Edinburgh, who gave me some interesting details of its distribution. Some months afterwards Dr. Semple of the Dumfries Academy

informed me that he and Mr. M'Cutcheon had gathered the same plant in the same locality in 1902 and transferred specimens to their gardens where it grows like a weed. He also said that it was believed in the district that the late Dr. Grierson of Thornhill had planted this and other rare alpines in the neighbouring glens.

This suggestion may or may not be correct, but the plant has apparently maintained itself for some twenty years in this particular locality. Considering that the Rev. Dr. Singer recorded *A. alpina*, L., for the county in 1843, it is perhaps advisable, in order to prevent controversy in the centuries to come, that these facts should be placed before the Society.

Additions to the Flora of Orkney, as recorded in Watson's "Topographical Botany," Second Edition (1883). By Colonel H. H. Johnston, C.B., C.B.E., D.Sc., F.R.S.E., F.L.S.

(Read 20th April 1922.)

This paper forms a continuation of four papers on the same subject, one of which I read before the Scottish Natural History Society on 4th April 1895, and which was published in "The Annals of Scottish Natural History," No. 15, pp. 173–181 (July 1895), and the other three before the Botanical Society of Edinburgh on 15th January 1914, 10th June 1920, and 17th March 1921, and which were published in the Society's "Transactions," vol. xxvi, pp. 207–217 (1914), and vol. xxviii, pp. 23–42 (1920), and pp. 51–66 (1921), respectively. Most of the plants mentioned in this paper were collected by me during the year 1921.

Before and after the publication of the second edition of Watson's "Topographical Botany," in 1883, several of the plants mentioned in the following list have been recorded from Orkney by me and other botanists; but as the value of botanical records is greatly enhanced by the possession of authentic specimens, I have included in this list the names of all specimens in my herbarium, which are either additional to or confirm doubtful records of the plants

recorded from County No. 111 Orkney in the second edition of the above-mentioned book.

In the case of those plants which have already been recorded from Orkney, references are given in the following list, under each species and variety, to the books in which the records have been published. These records are principally contained in "A Tour through some of the Islands of Orkney and Shetland," in the year 1804, by Patrick Neill (1806); "Notice of some of the rarer Plants observed in Orkney during the Summer of 1849," by John T. Syme, Esq., published in the "Transactions of the Botanical Society of Edinburgh," vol. iv, pp. 47–50 (1850); "Florula Orcadensis—A list of plants reported to occur in the Orkney Isles," by H. C. Watson, Esq., F.L.S., published in the "Journal of Botany," No. xiii, pp. 11–20 (January 1864); Annual Reports of the Botanical Exchange Club of the British Isles; "A new List of the Flowering Plants and Ferns of Orkney," edited by W. A. Irvine Fortescue, and published in "The Scottish Naturalist" (1882–1884); "Supplement to Topographical Botany, ed. ii," by Arthur Bennett, A.L.S. (1905); and "Flora Orcadensis," by Magnus Spence, F.E.I.S. (1914).

The nomenclature followed is that of the second edition of Watson's "Topographical Botany" (1883), except in the case of species and varieties which are not recorded in that work. In the latter case the nomenclature adopted is that of "The London Catalogue of British Plants," tenth edition (1908). Non-native plants, which have become naturalised in Orkney, are distinguished by a * prefixed to the names, and the names of casuals are printed in italics.

Of the 42 species, varieties, forms, and hybrids recorded from Orkney in the following list, 29 are native, 1 is naturalised, 10 are mere casuals introduced into Orkney through the agency of cultivation, and 2 were planted by man.

Abbreviations.

"Annals Scot. Nat. Hist." = The Annals of Scottish Natural History.
Bennett, "Suppl. Top. Bot." = Supplement to H. C. Watson's Topographical Botany, second edition. By Arthur Bennett, A.L.S. (1905).

"Bot. Exch. Club Report" (separate Reports by the Secretary and Distributor) = Report of The Botanical Exchange Club of the British Isles, at present called The Botanical Society and Exchange Club of the British Isles.
"Journ. Bot." = The Journal of Botany.
"Lond. Cat." = The London Catalogue of British Plants.
Neill, "Tour" = A Tour through some of the Islands of Orkney and Shetland, in the year 1804. By Patrick Neill, A.M., Secretary to the Natural History Society of Edinburgh (1806).
"Scot. Nat." = The Scottish Naturalist.
Spence, "Flora Orcadensis" = Flora Orcadensis. By Magnus Spence, F.E.I.S. (1914).
Watson, "Top. Bot." = Topographical Botany, second edition. By H. C. Watson (1883).

Corrections.

In "Trans. Bot. Soc. Edin.," vol. xxviii, p. 27 (1920), *for* "Sagina apetala, Ard. (*fide* Arthur Bennett)," *read* Sagina procumbens, Linn. (*fide* C. E. Salmon and Arthur Bennett), and *delete* "confirms the record of this species for H. C. Watson's County No. 111 Orkney by Mr. Patrick Neill in his 'Tour,' p. 185 (1806)."

In "Trans. Bot. Soc. Edin.," vol. xxviii, p. 58 (1921), after *Rhinanthus major*, Ehrh." *delete* "(name confirmed by Arthur Bennett)," and *substitute* var. c. *apterus*, Fries (*fide* C. E. Salmon).

In "Trans. Bot. Soc. Edin.," vol. xxvii, p. 57 (1916), in line 13 from top of page, *for* "Syme sp. 1888" *read* Boswell sp. 1880; and in line 20 from top of page, *for* "1852" *read* 1882.

Class I.—Dicotyledons.

Aquilegia vulgaris, Linn.—Roadside at farm steading, 100 feet above sea-level, Binscarth, Firth, Mainland, 2nd June 1921, Henry Halcro Johnston. Not native. Escape from a garden. Very rare. Plants beginning to flower. Petals purple.

The aggregate species *Viola tricolor*, Linn., is recorded from Orkney in Watson, "Topographical Botany," ed. ii, p. 57 (1883), but the following five species are not mentioned in that book. The nomenclature followed for these species is that of "The British Pansies," by Eric Drabble, D.Sc., F.L.S., reprinted from "The Journal of Botany" (1909):—

Group I.—arvenses.

Viola segetalis, Jordan, "Observations," ii, p. 12, t. Ib. (*fide* Arthur Bennett and W. G. Travis).—The same specimens were identified as "*Viola arvensis*, Murr.," by the late Dr. J. T. I. B. Boswell. Corn-field, Hurkisgarth, Sandwick, Mainland, 4th August 1886, H. H. Johnston. Not native. A weed of cultivation. Plants in full flower. See "Bot. Exch. Club Report for 1886," p. 145 (1887); "Scot. Nat.," No. xxv, new series, p. 112 (July 1889); "Bot. Exch. Club Report for 1900," p. 623 (1901); "Annals Scot. Nat. Hist." No. 15, p. 175 (July 1895); Bennett, "Suppl Top. Bot." p. 15 (1905); and Spence, "Flora Orcadensis," p. 8 (1914).

Group II.—tricolores.

Viola Lloydii, Jordan in Boreau, "Fl. du Centre," ed. 3, ii, p. 80 (*fide* W. G. Travis).—Corn-field, Hangaback, Gyre, Orphir, Mainland, 7th August 1874, H. H. Johnston (the same specimen was identified as "*Viola tricolor*, Linn.," by the late Dr. J. T. I. B. Boswell); shell-sandy hay-field, 20 feet above sea-level, Quoyerland, Lady, Sanday, 17th May 1921, H. H. Johnston; gravelly burnside, 130 feet above sea-level, Burn of Vacquoy, Rousay, 20th July 1921, H. H. Johnston; plants growing among *Ulex europaeus, *Linn.*, at the side of a road between an oat-field and a grass-field, 190 feet above sea-level, Sunnybrae, Saint Ola, Mainland, 16th August 1921, H. H. Johnston; and oat-field, 40 feet above sea-level, Quoys, South Ronaldsay, 6th September 1921, H. H. Johnston. Not native. A weed of cultivation, confined in Orkney to cultivated land, where it is common, and to the borders of cultivated land, as at the Burn of Vacquoy in Rousay and Sunnybrae in Mainland, where it is rare. Plants in full flower at all the above-mentioned five stations, and at Sunnybrae some plants were sparingly in fruit on 18th September 1921. The following notes were made by me from living plants, at Sunnybrae in Mainland, on 16th August 1921:—Flowers inodorous. Two upper petals uniformly violet, with faint dark violet veins; two lateral petals purplish-blue, with 3–4 dark violet veins; lower petal purplish-blue, with 7

dark violet veins, and a yellow base; spur of lower petal longer than the calycine appendages, dull purple. Anther-spurs filiform, with subclavate extremities. Stigma pale greenish-yellow. The colour of the flowers at the other four stations was the same as that of those at Sunnybrae, and at all the stations the *yellow* colour of the corolla was confined to the *base* of the *lower petal*.

Viola variata, Jordan, "Pugillus," p. 26 (*fide* W. G. Travis).—Corn-field, Hurkisgarth, Sandwick, Mainland, 4th August 1886, H. H. Johnston (the same specimen was identified as "*Viola tricolor*, Linn.," by the late Dr. J. T. I. B. Boswell); and plants growing among *Viola Lloydii*, Jordan, and *Ulex europaeus, *Linn.*, at the side of a road between an oat-field and a grass-field, 190 feet above sea-level, Sunnybrae, Saint Ola, Mainland, 16th August 1921, H. H. Johnston. Not native. A weed of cultivation. Rare at Sunnybrae. Plants in full flower at both stations. The colour of the flowers is similar to that of *Viola Lloydii*, Jordan, growing at the same station. See "Bot. Exch. Club Report for 1886," p. 145 (1887).

Group III.—saxatiles.

Viola lepida, Jordan, "Pugillus," p. 28 (*fide* W. G. Travis).—Marshy hillside, 460 feet above sea-level, Hill of Miffia, Stromness, Mainland, 18th June 1920, H. H. Johnston. Not native. One plant only seen by me growing on the marshy hillside, within quarter of a mile of the highest cultivated land in Orkney, which on the Hill of Miffia reaches an elevation of 500 feet above sea-level. Plant in flower.

Group V.—curtisieae.

Viola pesneaui, *E. G. Baker* in "Journ. Bot," vol. xxxix, p. 9 (1901) (*fide* W. G. Travis).—Plants growing among Psamma arenaria, *R. et S.*, and mosses, in shell-sandy links near the seashore, 10–15 feet above sea-level, Sty Wick, Lady, Sanday, 29th May 1920 and 17th May 1921, H. H. Johnston; plants growing among Psamma arenaria, *R. et S.*, in shell-sandy links near the seashore, 15 feet above sea-level, Quoy Ness, Cross, Sanday, 25th August 1920, H. H. Johnston; and plants growing among Psamma

ARENARIA, *R. et S.*, in shell-sandy links near the seashore, 10 feet above sea-level, Backaskaill Bay, Cross, Sanday, 16th May 1921, H. H. Johnston. Native, common, and plants in full flower at all these three stations. A new record for this species for H. C. Watson's county No. 111 Orkney. The following notes were made by me from living plants at Sty Wick, on 17th May 1921:—Subterranean perennating stems many, wiry, branched, turning upwards and bearing foliage-leaves, and flowers. Two upper petals uniformly violet; two lateral petals purplish-blue, with dark violet lines; lower petal purplish-blue, with dark violet lines, and a yellow base. Anther-spurs long, filiform. The colour of the flowers at Quoy Ness and Backaskaill Bay was the same as that of those at Sty Wick. This pretty-flowered and truly native species is an interesting addition to the flora of Orkney.

Silene inflata, Sm. [=*Silene cucubalus*, Wibel, and *Silene latifolia*, Rendle et Britten] (*fide* Arthur Bennett).—Grassy border of an oat-field, 130 feet above sea-level, Kierfiold, Sandwick, Mainland, 6th August 1921, H. H. Johnston. Not native. A weed of cultivation. Common. Plants in full flower. Calyx inflated, dull purplish-green. Petals white. Styles 3, white. Plants in ripe fruit on 4th October 1921. Removes "[111]" from among the "supposed errors" in Watson, "Top. Bot.," ed. ii, p. 64 (1883). In the Rev. Dr. Barry's "History of the Orkney Islands," ed. ii, p. 281 (1808), "CUCUBALUS, *Behen*" [=the old name of *Silene inflata*, Sm.] is mentioned, but the Rev. George Low and Rev. Dr. Barry have confounded SILENE MARITIMA, *With.*, with this species, as is explained by Mr. Patrick Neill in his "Tour," p. 186, footnote || (1806), under "Silene maritima ||." See "Journ. Bot.," No. xiii, p. 13 (January 1864), where the "?" should be removed from "Silene inflata?" and *ibid.*, p. 18, where Mr. H. C. Watson states, "I can only guess here that *S. nutans* of Low intended the typical *S. inflata*, apart from *S. maritima*." In the Rev. Dr. Barry's "History of the Orkney Islands," ed. ii, p. 281 (1808), the following record occurs:—"SILENE *Nutans*. Nottingham catch-fly. In a meadow of Binaskart." Confirms the record of this species from Orkney ("near Lynn, Kirkwall"), by Dr. A. R. Duguid in

his manuscript "Flora Orcadensis" (1858). Removes the "(?)" from "111(?)" under Silene Cucubalus, *Wibel*, in "Annals Scot. Nat. Hist.," No. 26, p. 100 (April 1898). See "Annals Scot. Nat. Hist.," No. 56, p. 229 (October 1905); and Spence, "Flora Orcadensis," p. 9 (1914), where the plant "Found on farm of Keigar, Deerness, in 1904; introduced with seeds," is *Silene dichotoma*, Ehrh. (*fide* Arthur Bennett), which has been confounded with *Silene cucubalus*, Wibel, by the late Mr. Magnus Spence.

Sagina nodosa, *Fenzl., var. b.* glandulosa (*Bess.*) (*fide* C. E. Salmon).—Meadow at Scapa, Saint Ola, Mainland, 25th July 1876, H. H. Johnston; damp loch-shore, Groundwater, Loch of Kirbister, Orphir, Mainland, 9th August 1878, H. H. Johnston; marsh, 20 feet above sea-level, Loch of Saintear, Westray, 23rd August 1913, H. H. Johnston; marshy burnside, 20 feet above sea-level, Selwick, Hoy, 8th September 1914, H. H. Johnston; and marsh, 60 feet above sea-level, Graemston, South Ronaldsay, 6th September 1921, H. H. Johnston. Native, rare, and plants in flower at all these five stations. Petals white, entire. This variety is more common in Orkney than the type of the species, of which latter I have specimens only from North Ronaldsay, collected by me on 20th and 23rd August 1920, and even in these specimens a few glands are present. Confirms the record for this variety from Orkney in Spence, "Flora Orcadensis," p. 12 (1914).

Rosa omissa, *Déségl., var. b.* resinosoides, *Crépin.* (*fide* William Barclay).—Grassy banks at burnside, 100 feet above sea-level, Trumland Burn, Rousay, 25th August 1921, H. H. Johnston (plants in unripe fruit); and 7th November 1921, John Logie (plants in ripe fruit). Native. Rare. With reference to my specimens, Mr. William Barclay, in a note dated 6th March 1922, writes as follows:—"The variety is hardly separable from the type except by its longer peduncles." A new record for this variety for H. C. Watson's county No. 111 Orkney. This plant is probably the same as the "Rosa villosa, Apple-rose, Trumbland, Rousay," recorded by Mr. Patrick Neill in his "Tour," p. 187 (1806); in Dr. A. R. Duguid's manuscript "Flora Orcadensis" (1858); and in "Journ. Bot.," No. xiii, p. 14 (1864).

Rosa glauca, *Vill., var. c.* subcanina, *Christ.* (*fide* William Barclay).—Grassy banks at burnside, 250 feet above sea-level, Upper Dowscarth, Russa Dale, Stenness, Mainland, 27th September 1921 (plants in unripe fruit), and 11th November 1921 (plants in ripe fruit), H. H. Johnston. Native. Rare. A new record for this variety for H. C. Watson's county No. 111 Orkney.

[*Valeriana pyrenaica*, Linn. — Plantation of trees, 80 feet above sea-level, Binscarth, Firth, Mainland, 2nd June 1921, H. H. Johnston. Not native. Plants introduced into Orkney and planted at Binscarth prior to 1880, since which time the plants have multiplied and spread in the plantation, where they are now common. Plants in flower. —Corolla lilac. This species is recorded from Orkney in "Annals Scot. Nat. Hist.," No. 27, p. 173 (July 1898); and in Spence, "Flora Orcadensis," p. 33 (1914); but having been planted in an artificial plantation of trees, and being still confined to that plantation, it has no claim to be included in the flora of Orkney, any more than the exotic trees in the same plantation.]

The aggregate species Taraxacum officinale, *Wigg.*, is recorded from Orkney in Watson, "Top. Bot.," ed. ii, p. 236 (1883), but the following segregate species are not mentioned in that book :—

Taraxacum devians, *Dahlstedt* (*fide* Hugo Dahlstedt).—Natural shell-sandy pasture near the seashore, 15 feet above sea-level, Links of Boardhouse, Birsay, Mainland, 29th April 1921, H. H. Johnston. Native. Common. A new record for this species for H. C. Watson's county No. 111 Orkney. Plants in flower. Outer phyllaries recurved in flower; inner phyllaries simple at the apex (not gibbous or appendaged). Corolla yellow, striped dull purplish beneath. Anthers purplish-yellow. Style and its two branches pale brownish-yellow. Plants in fruit on 6th June 1921. Fruit receptacle flattish-convex. Achenes brown. Dr. Hugo Dahlstedt informs me that this species also grows in the Faeroes.

Taraxacum unguilobum, *Dahlstedt* (*fide* Hugo Dahlstedt).—Damp natural pasture near the seashore, 10 feet above sea-level. Isgarth, Lady, Sanday, 29th May 1920, H. H. Johnston. Native. Common. A new record for

this species for H. C. Watson's county No. 111 Orkney. Plants in flower, and a few plants sparingly in fruit. Leaves dull green above, paler green beneath. Outer phyllaries adpressed in flower; inner phyllaries simple at the apex (not gibbous or appendaged). Fruit-receptacle flattish, with a concave centre and convex margin. Achenes brown. Dr. Hugo Dahlstedt informs me that this species also grows in western Norway between Bergen and Hardanger.

Taraxacum faeroense, *Dahlstedt* (*fide* Hugo Dahlstedt).—Marshy heath, 430 feet above sea-level, Myres, near Muckle Water, Rousay, 18th June 1921, H. H. Johnston. Native. Common. A new record for this species for H. C. Watson's county No. 111 Orkney. Plants in full flower and sparingly in fruit. Dr. Hugo Dahlstedt informs me that this species also grows in Scotland, Faeroes, Iceland, and western Norway.

Taraxacum.—Shell-sandy links at seashore, 10 feet above sea-level, Bay of Skaill, Sandwick, Mainland, 21st June 1919, H. H. Johnston. Native. Common. Same individual plants in flower and fruit at the same time. Leaves runcinate—pinnatifid, with small lobes between the large lobes; midrib purplish; blade dull green above, paler somewhat glaucous-green beneath. Outer phyllaries recurved or spreading both in flower-bud and in flower, oblong-lanceolate, acuminate; inner phyllaries strap-shaped, gibbous, and appendaged at the apex. Achenes olive-coloured, spinulose—muricated at the apex; beak thickened at the base. With reference to my specimens, Reference No. 457, Dr. Hugo Dahlstedt, in a note dated 12th January 1922, writes as follows:—"This form belongs to Vulgaria [=T. officinale (coll.) olim] and seems to be allied to T. angustisquameum, *Dahlstedt*. But probably it is a new related species." My specimens do not agree with the description of any of the varieties of Taraxacum officinale, *Wiggers*, mentioned in "English Botany," ed. iii, pp. 142 and 143 (1873).

Campanula rotundifolia, Linn.—Grassy border of an oat-field, 200 feet above sea-level, about $\frac{1}{4}$ mile north of Sunnybank House, Saint Ola, Mainland, 16th August 1921, H. H. Johnston. Not native. One small clump of

plants only seen by me. Plants in flower and unripe fruit. Corolla blue.—Stigma 3-cleft, pale yellow.

* Mimulus luteus, *Linn.* (*fide* Arthur Bennett and W. B. Turrill).—Marshy shell-sandy burnside at the seashore, 5 feet above sea-level, Sandside Bay, Deerness, Mainland, 21st June 1921, H. H. Johnston. Naturalised. Common in the burn between Netherstove, 120 feet above sea-level, and the seashore. Plants of this species were thrown out of the garden at Netherstove into the burn by Miss Elizabeth Ritch about 1911, since which time they have become thoroughly naturalised in the burn below the garden, in which also they still continue to grow under cultivation. Plants in full flower. Corolla yellow, with dark maroon blotches on the lobes of the limb (hence the name "Blood-drop" given to this garden plant in Orkney). Mr. W. B. Turrill, in a note dated 24th February 1922, writes as follows:—"Mimulus luteus, *Linn.*, *i.e.* the S. American plant. M. Langsdorfii, *Donn.*, differs in the inflorescence and in the shape of the corolla. Numerous colour forms are cultivated."

Euphrasia stricta, *Host.* (*fide* Cedric Bucknall and Dennis Lumb).—Natural pasture, 170 feet above sea-level, Holland, South Ronaldsay, 6th September 1921, H. H. Johnston. Native. Common. Plants in full flower, and sparingly in fruit. Leaves 2–10 toothed. Corolla large, with a pale lilac upper lip, and white lower lip marked with a yellow spot on the throat, and with dark purple lines on both lips. A new record for this species for H. C. Watson's county No. 111 Orkney.

Euphrasia minima, *Jacq.* (*fide* Cedric Bucknall and Dennis Lumb).—Moist heath, 170 feet above sea-level, Gairy Hill, South Ronaldsay, 1st September 1921, H. H. Johnston. Native. Common. Plants in full flower. Leaves 2–6 toothed. Corolla small, with a light purple upper lip, and white lower lip marked with a yellow spot on the throat, and with dark purple lines on both lips. A new record for this species for H. C. Watson's county No. 111 Orkney.

Rhinanthus stenophyllus, *Schur.* (*fide* C. E. Salmon). —Scapa, Saint Ola, Mainland, 25th July 1876, H. H. Johnston; Hoy, 9th July 1877, H. H. Johnston; grassy

and heathery banks at loch-side, 5 feet above sea-level, Seatter, Loch of Stenness, Stromness, Mainland, 15th August 1919, H. H. Johnston; artificial pasture, 20 feet above sea-level, Point of Onston, near the Bridge of Waith, Stenness, Mainland, 3rd August 1920, H. H. Johnston; grassy and heathery pasture, 10 feet above sea-level, Point of Onston, Stenness, Mainland, 9th August 1920, H. H. Johnston; natural grassy and heathery pasture, 30 feet above sea-level, Deepdale, Stromness, Mainland, 14th August 1920, H. H. Johnston; and natural heathery and grassy pasture, 40 feet above sea-level, Purtabreck, North Ronaldsay, 20th August 1920. H. H. Johnston. Native and common at all these stations. The flowering season of this species in Orkney lasts from June to August, the earliest and latest dates of flowering observed by me being 6th June 1921 and 15th August 1919, respectively. The flowers are in greatest profusion during July, while in August the plants are mostly in ripe fruit. Mr. C. E. Salmon is of opinion that my specimens from Seatter, Point of Onston, and Deepdale, are only "small examples of R. STENOPHYLLUS, *Schur.*," and he has not identified any of them as R. RUSTICULUS, *Sterneck*, although my specimens from the Point of Onston and Deepdale were collected at the same stations as the plants referred to by Dr. G. Claridge Druce in "Bot. Exch. Club Secretary's Report for 1920," p. 140 (September 1921). The stem of my smallest specimen from Deepdale is only 4 cm. ($1\frac{1}{2}$ inch) long, and the leaves are 3 5 mm. long and 1 mm. broad. RHINANTHUS STENOPHYLLUS, *Schur.*, is more common in Orkney than R. CRISTA-GALLI, *Linn.* [= R. MINOR, *Ehrh.*] (*fide* C. E. Salmon), of which I have specimens only from grassy cliffs at the seashore, 40 feet above sea-level, collected by me at Scapa, Saint Ola, Mainland, on 5th July 1912. This latter species is also native, and it was in flower and unripe fruit on 5th July 1912, with green bracts, and a yellow corolla, with the two lateral lobes of the upper lip small, short, roundish, and dark purple in colour. See "Journ. Bot.," vol. xxxix, p. 270 (August 1901), and vol. xli, p. 295 (1903); "Bot. Exch. Club Report for 1903," p. 7 (April 1904); and "Trans. Bot. Soc. Edin.," vol. xxvii, p. 56 (1916).

Lamium album, Linn.—Artificial pasture, 20 feet above sea-level, farm-steading of the glebe of the Established Church Manse, Holm, Mainland, 12th May 1921 (plants not in flower or fruit), and 22nd June 1921 (plants in full flower), H. H. Johnston. Not native. Rare. Corolla pale yellowish-white. Confirms the record of this species from Orkney in the Rev. Dr. Barry's "History of the Orkney Islands," ed. ii, p. 283 (1808). See "Journ. Bot," No. xiii, p. 15 (January 1864); "Scot. Nat.," No. xlviii, p. 373 (October 1882); Watson, "Top. Bot.," ed. ii, p. 314 (1883); "Annals Scot. Nat. Hist.," No. 30, p. 100 (April 1899); and Spence, "Flora Orcadensis," p. 56 (1914).

Myosotis collina, Hoffm. (*fide* Arthur Bennett).—Turf top of stone wall and grassy floor of old Monastery in ruins, 30 feet above sea-level, Eynhallow, 24th August 1921, H. H. Johnston. Not native. Common at the Monastery. Plants in full flower and sparingly in fruit. Stem clothed with straight spreading hairs. Calyx clothed with spreading hairs, hooked at the apex. Corolla small, with a blue limb and yellow throat. Confirms the record of this species from Orkney by the late Mr. Magnus Spence in his "Flora Orcadensis," p. 58 (1914).

Lysimachia punctata, Linn. (*fide* Arthur Bennett).—Grassy bank at side of a mill pond, 80 feet above sea-level, Gyre, Orphir, Mainland, 28th July 1921, H. H. Johnston. Not native. Escape from a garden. Rare. Plants in full flower. Confirms Dr. G. Claridge Druce's record of this species from Orkney ("near Stenness") in "Bot. Exch. Club Secretary's Report for 1920," p. 135 (September 1921). I first saw this plant growing wild in Orkney, at a burnside, at Newhouse, Clestrain, Orphir, Mainland, on 21st August 1914, on which date Mr. Peter Goudie informed me that, several years previously, plants of this species had been transplanted from his garden at Newhouse to the burnside, where they have continued to grow, multiply, and spread.

ATRIPLEX GLABRIUSCULA, *Edmondston, var. b.* VIRESCENS, *Moss et Wilmott* in "The Cambridge British Flora," vol. ii, p. 178 (1914) (*fide* A. J. Wilmott). [=ATRIPLEX BABINGTONII, *Woods, var. b.* VIRESCENS, *Lange*, "Haanb. Danske Fl.," p. 712 (1864); and "Lond. Cat.," ed. x (1908); but *not* ATRIPLEX GLABRIUSCULA, *Edmondston, var. a.* BABINGTONI,

Moss et Wilmott in "Camb. Brit. Flora," vol. ii, p. 178, plate 182 (1914)].—Shingly seashore, Scapa, Saint Ola, Mainland, 25th July 1876, H. H. Johnston; stony ground near edge of sea-cliffs, Ramna Geo, Sandwick, Mainland, 23rd July 1886, H. H. Johnston (my specimens from these two stations were identified as "ATRIPLEX BABINGTONII, *Woods*," by the late Dr. J. T. I. B. Boswell); shell-sandy and shingly seashore, 5 feet above sea-level, Backaskaill Bay, Cross, Sanday, 25th August 1920 and 8th and 9th October 1921, H. H. Johnston; rocky seashore, 20 feet above sea-level, Eynhallow, 24th August 1921, H. H. Johnston; shell-sandy seashore, 5 feet above sea-level, Saviskaill, Rousay, 25th August 1921, H. H. Johnston, and 5th October 1921, Mark McKay Kirkness; site of a former heap of seaweed on pasture at seashore, 10 feet above sea-level, Langskaill, Rousay, 25th August 1921, H. H. Johnston, and 22nd October 1921, Mark McKay Kirkness; shingle at seashore, 5 feet above sea-level, Muckle Skerry, Pentland Skerries, 5th September 1921, H. H. Johnston; and shingle at seashore, 5 feet above sea-level, Wind Wick, South Ronaldsay, 7th September 1921, H. H. Johnston. Native, and common at all these eight stations, except Eynhallow and Muckle Skerry, where this variety is rare.

Note.—The *var. b.* VIRESCENS, *Moss et Wilmott*, is the common seashore ATRIPLEX in Orkney, and it is the plant that has been recorded under the name of "ATRIPLEX BABINGTONII, *Woods*," in "Journ. Bot.," No. xiii, p. 16 (January 1864); Watson, "Top. Bot.," ed. ii, p 348 (1883); "Scot. Nat.," No. i, new series, p. 21 (July 1883); "Annals Scot. Nat. Hist.," No. 30, p. 101 (April 1899); and Spence, "Flora Orcadensis," p. 61 (1914).

I have not found the *var. a.* BABINGTONI, *Moss et Wilmott*, in Orkney.

[*Rheum Rhaponticum*, Linn.—Grassy cliffs at seashore, 20 feet above sea-level, Turnpike, Dingieshowe Bay, Saint Andrews, Mainland, 12th May 1921, H. H. Johnston; and grassy and shingly seashore, 5 feet above sea-level, Stembuster, Clivie Bay, Saint Andrews, Mainland, 12th May 1921, H. H. Johnston. Not native. One plant at Turnpike, and two large clumps of plants at Stembuster,

only seen by me. Plants not in flower or fruit. Mr. J. Anderson, Turnpike, *in litt.*, dated 27th February 1922, informs me that the Rhubarb plant now growing on the grassy cliffs at Turnpike was taken out of the garden at Turnpike House about 1912 and thrown over the cliffs, and that Mr. David Laughton, Greens, Saint Andrews, Mainland, Orkney, seeing it lying there, planted it. Mr. James Skea, Stembuster, *in litt.*, dated 2nd March 1922, informs me, with reference to the two large clumps of Rhubarb growing on the seashore below Stembuster House, that some Rhubarb plants were thrown out of the garden at Stembuster, and that "a man James Laughton planted them below the beach about 30 years ago, and there they have grown and thriven without any cultivation, many times in winter being covered with foam of the sea." Mr. J. Skea also informs me that the Rhubarb plants growing at Stembuster seashore produce flowers.]

SALIX PHYLICIFOLIA, *Linn.* × REPENS, *Linn.* ♂ and ♀. —Ditch side, 50 feet above sea-level, Meadow of Greenay, Birsay, Mainland, 26th May 1921 (plants in flower), and 29th June 1921 (male plants in leaf only, and female plants in leaf and ripe fruit), H. H. Johnston. Native. Rare. Plants growing among SALIX REPENS, *Linn.*, and within 200 yards of SALIX PHYLICIFOLIA, *Linn.* The young leaves of the male and female plants in flower on 26th May 1921 were green above, paler green beneath, and thinly clothed on both surfaces with short, adpressed, whitish hairs. With reference to my male specimens, the Rev. E. F. Linton, in a note dated 29th December 1921, writes as follows:—"S. PHYLICIFOLIA × REPENS very possibly. On the scanty material I don't feel positive," and, with reference to my female specimens, he writes as follows:—"S. PHYLICIFOLIA × S. REPENS, is a very likely solution. In most respects differing little from S. REPENS. There is the broader leaf in 1267 [my Reference No., H. H. Johnston], and in some cases the styles, usually very short, are slightly or pl. m. elongate. The buds are indeterminate, but seem to indicate something besides REPENS, and being ± pointed approach S. PHYLICIFOLIA." A new record for this hybrid for H. C. Watson's county No. 111 Orkney.

POTAMOGETON PECTINATUS, *Linn.*, *var.* DIFFUSUS, *Hag-*

ström (*fide* Arthur Bennett).—Mud at bottom of water, 3 feet deep, in a loch, 12 feet above sea-level, Loch of Wasbister, Rousay, 19th July 1921, H. H. Johnston. Native. Common. Plants in flower, and wholly submerged in water. A new record for this variety for H. C. Watson's county No. 111 Orkney.

POTAMOGETON PECTINATUS, *Linn.*, *var.* UNGULATUS, *Hagström* (*fide* Arthur Bennett).—Mud at bottom of nearly fresh water, Bay of Islands, Loch of Harray, Stenness, Mainland, 26th September 1921, H. H. Johnston. Native. Common in the channel between Long Holm and the small island immediately to the south-east of it. Plants in ripe fruit. With reference to my specimens, Mr. Arthur Bennett, in a note dated 19th November 1921, writes as follows:—"The rigid lower sheaths and leaves are a characteristic of this." A new record for this variety for H. C. Watson's county No. 111 Orkney.

POTAMOGETON FILIFORMIS, *Nolte*, *form* ALPINUS, *Blytt*, "Norges Flora," vol. i, p. 370 (1861) (*fide* Arthur Bennett).—Mud at bottom of brackish water, 5 feet deep, in a loch at sea-level, near the *noust* for boats, Nether Bigging, Loch of Stenness, Stenness, Mainland, 2nd August 1920, H. H. Johnston; and shell-sandy mud at bottom of water, about 1 foot deep, in a loch 10 feet above sea-level, Loch of Rummie, Lady, Sanday, 27th August 1920, H. H. Johnston. Native, common, and plants in flower at both stations. A new record for this form for H. C. Watson's county No. 111 Orkney.

POTAMOGETON FILIFORMIS, *Nolte*, *form* LUXURIOSUS, *Hagström* in Neuman's "Sveriges Flora," p. 794 (1901) (*fide* Arthur Bennett).—Mud at bottom of brackish water in a loch, almost at sea-level, near the Bridge of Brogar, Loch of Harray, Stenness, Mainland, 24th September 1880, H. H. Johnston; and mud at bottom of running water, $1\frac{1}{4}$ foot deep, in a burn, 26 feet above sea-level, Skaill Burn, Sandwick, Mainland, 4th October 1921, H. H. Johnston. Native, common, and plants in ripe fruit at both stations. A new record for this form for H. C. Watson's county No. 111 Orkney.

POTAMOGETON FILIFORMIS, *Nolte*, *form* MAJOR, *Tiselius*, "Exsic. Suec.," fas. 3, Nos. 114 and 115 (1897) (*fide* Arthur

Bennett).—Mud at bottom of stagnant water, Birsay, Mainland, 26th July 1883, H. H. Johnston; and mud at bottom of shallow water in a loch, 11 feet above sea-level, Loch Echna, Burray, 27th July 1914, H. H. Johnston. Native. Rare at Loch Echna. Plants in fruit at both stations. A new record for this form for H. C. Watson's county No. 111 Orkney.

Potamogeton panormitanus, *Bivona* (*fide* Arthur Bennett).—Mud at bottom of water in a loch, 49 feet above sea-level, Loch of Kirbister, Orphir, Mainland, 9th August 1878 (plants in unripe fruit) and 30th August 1880 (plants not in flower or fruit), H. H. Johnston. Native. A new record for this species for H. C. Watson's county No. 111 Orkney, published by Dr. G. Claridge Druce in "Bot. Exch. Club Secretary's Report for 1920," p. 152 (September 1921).

Potamogeton lucens, *Linn.* (name confirmed by Arthur Bennett), and *var.* insignis, *Tiselius* (*fide* Arthur Bennett). —Mud at bottom of water, 11 feet deep, in a loch, 323 feet above sea-level, Muckle Water, Rousay, 23rd July 1921 (plants in flower-bud) and 22nd August 1921 (plants in full flower), H. H. Johnston. Native. Common. Plants submerged in water except the flower-spikes. Mr. Arthur Bennett, to whom all my specimens were submitted, writes as follows, in a note dated 1st December 1921:—"There is no doubt the whole of these specimens must be named P. lucens, *Linn.* As a rule the leaves are narrower than the type specimen in the Linnean herbarium. I have looked up my seventy-six specimens from all over the world where lucens occurs and there is nothing that exactly matches your specimens." A few of my specimens Mr. Arthur Bennett has identified as *var.* insignis, *Tiselius*. Confirms the record of this species from Orkney (no station mentioned) in the Rev. Dr Barry's "History of the Orkney Islands," ed. ii, p. 278 (1808); and the *var.* insignis, *Tiselius*, is a new record for H. C. Watson's county No. 111 Orkney. See "Journ. Bot.," No. xiii, p. 16 (January 1864); Watson, "Top. Bot.," ed. ii, p. 417 (1883), where county No. 111 Orkney is shown thus "[10, 111, 112; errors?]"; "Annals Scot. Nat. Hist.," No. 31, p. 171 (July 1899); Bennett, "Suppl. Top. Bot.," p. 84 (1905); Spence, "Flora

Orcadensis," p. 72 (1914), where the record "Stromness (1910; Dr. Grant)" is an error; and "Trans. Bot. Soc. Edin.," vol. xxviii, p. 57 (1920).

POTAMOGETON PRAELONGUS, *Wulfen.* (name confirmed by Arthur Bennett).—Mud at bottom of water, 1½ foot deep, in old quarry holes in the bed of a loch near the shore, 13 feet above sea-level, north-east and south-west of the windmill pumping station (formerly a boat-house), Loch of Tankerness, Saint Andrews, Mainland. Native. Rare. Plants not in flower or fruit. Confirms the record of this species from Orkney ("Loch of Tankerness") by the late Mr. Magnus Spence in his "Flora Orcadensis," p. 71 (1914).

POTAMOGETON HETEROPHYLLUS, *Schreb., form* GRACILIS (*Wolfg.*) [=POTAMOGETON WOLFGANGII, *Kihlman*] (*fide* Arthur Bennett).—Mud at bottom of water, 4 feet deep, in a loch, 13 feet above sea-level, Loch of Tankerness, Saint Andrews, Mainland, 19th July 1883 and 12th August 1921, H. H. Johnston. Native. Common. Plants in flower, without any floating leaves. A new record for this form for H. C. Watson's county No. 111 Orkney. I have a specimen of POTAMOGETON HETEROPHYLLUS, *Schreb.* (*fide* Arthur Bennett), with floating leaves, collected by me, in the Loch of Tankerness, on 12th August 1921.

POTAMOGETON HETEROPHYLLUS, *Schreb., var.* INTERMEDIUS (*Tiselius*) (*fide* Arthur Bennett).—Mud at bottom of water, 5 feet deep, in a loch, 49 feet above sea-level, Loch of Kirbister, Orphir, Mainland, 9th August 1878 and 30th August 1880, H. H. Johnston. Native. Common. Plants in fruit, with and without floating leaves. Confirms the record of this variety from Orkney (Loch of Kirbister), in "Scot. Nat.," No. i, new series, p. 24 (July 1883). See "Bot. Exch. Club Report for 1880," p. 36 (1881), with reference to a "form with broad-based submerged leaves," of POTAMOGETON HETEROPHYLLUS, *Schreb.*, collected by the late Dr. J. T. I. B. Boswell, in the Loch of Kirbister, in July 1875; "Journ. Bot.," vol. xxxix, p. 273 (August 1901); "Annals Scot. Nat. Hist.," No. 71, p. 180 (July 1909); and Spence, "Flora Orcadensis," p. 73 (1914).

POTAMOGETON NITENS, *Weber, var.* SUBGRAMINEUS, *Hagström, form* STENOBASIS, *Hagström* (*fide* Arthur Bennett).—Mud at bottom of nearly fresh water, 3 feet

deep, in a loch almost at sea-level, Bay of Islands, Loch of Harray, Harray, Mainland, 2nd August 1920, H. H. Johnston. Native. Rare. Plants in flower. Peduncles 4–5 inches long, with flower spikes $\frac{5}{8}$–1 inch long. My specimen and the specimens collected at the same time by Prebendary R. J. Burdon and Dr. G. Claridge Druce, in my company, grew sparingly in the channel between Ling Holm and the small island immediately to the north of it. With reference to my specimen, Mr. Arthur Bennett, in a note dated 11th November 1920, writes as follows:—"A very peculiar plant. If NITENS it will come under *d.* SUBGRAMINEUS, *Hagström, form* STENOBASIS, *Hagström,* 'Critical Researches on Potamogeton,' p. 224 (1916); seems to be recorded only from Sjögesäter in Sweden. It is the nearest form to HETEROPHYLLUS." See "Bot. Exch. Club Report for 1872–1874," p. 40 (1875), where under P. NITENS, *Weber,* Dr. J. T. I. B. Boswell writes as follows: —"A single specimen gathered by me in the Bay of Islands, Upper Loch of Stenness [the Loch of Harray is meant—H. H. Johnston], August 1873"; and, with reference to Dr. Boswell's specimen, Mr. Arthur Bennett, in "Scot. Nat.," No. i, new series, p. 24 (July 1883), writes as follows:— "I believe this is correct; it is of course widely different from the *curvifolius, Hait.,* and comes between Weber's type and *var. latifolius, Tis.!*" See also "Bot. Exch. Club Secretary's Report for 1920," p. 151 (September 1921).

POTAMOGETON POLYGONIFOLIUS, *Pourr., var.* CORDIFOLIUS, *Asch. et Graebn.* (*fide* Arthur Bennett).—Mud at bottom of water in a ditch in a peat moss, Kingsdale, Firth, Mainland, 15th September 1880, H. H. Johnston. Native. Plants in fruit. A new record for this variety for H. C. Watson's county No. 111 Orkney.

ISOETES LACUSTRIS, *Linn.* (name confirmed by Arthur Bennett).—Mud at bottom of water, 7 feet deep, in a loch, 328 feet above sea-level, Peerie Water, Rousay, 22nd August 1921, H. H. Johnston. Native. Common in the deepest parts of the loch where the bottom is muddy. Plants in full fructification, growing close together in dense tufts, and wholly submerged in water. Leaves suberect, or recurved, subulate, roundish-quadrangular, dark green, with four longitudinal jointed tubes. Larger spores globose,

bluntly tubercled, pale yellowish-white. I found no plants of this species growing on the stony bottom of the shallow water along the margin of the loch, where flowerless plants of Littorella lacustris, *Linn.*, grow in abundance. Confirms the late Mr. Robert Heddle's record of this species from Rousay, in "Scot. Nat.," No. iii, new series, p. 113 (January 1884); and the late Mr. Alexander Somerville's record of it from Peerie Water, Rousay, 12th July 1901, in Bennett, "Suppl. Top. Bot.," p. 114 (1905), and in "Trans. Bot. Soc. Edin.," vol. xxvii, p. 58 (1916). See "Annals Scot. Nat. Hist.," No. 34, p. 107 (April 1900); and Spence, "Flora Orcadensis," p. 96 (1914). The late Dr. A. R. Duguid recorded Isoetes lacustris, *Linn.*, from the Loch of Carness, Saint Ola, Mainland, in his manuscript "Flora Orcadensis," (1858), but this record is most probably an error, because the Loch of Carness is a tidal one and contains brackish water, and on 16th September 1921 I failed to find either this species or Littorella lacustris, *Linn.*, in the loch.

Chara contraria, *Kützing* (*fide* James Groves).—Gravelly mud at bottom of shallow running water in a burn, 200 feet above sea-level, Quendale, Rousay, 15th June 1921, H. H. Johnston; mud at bottom of water, 5 feet deep, in a loch, 28 feet above sea-level, Loch of Bosquoy, Harray, Mainland, 30th September 1921, H. H. Johnston; and shell-sandy mud at bottom of water, 1½ foot deep, in a loch, 10 feet above sea-level, North Loch, Lady, Sanday, 8th October 1921, H. H. Johnston. Native. Rare at Quendale, and common in the Loch of Bosquoy. Plants slightly fetid, wholly submerged in water, and at the Loch of Bosquoy and North Loch they were in fructification. In a sheet of Chara aspera, *Willd.*, collected by the late Mr. F. C. Crawford, in the Loch of Skaill, Sandwick, Mainland, Orkney, in September 1901, and now in the herbarium of Mr. James Groves, there are a few scraps of Chara contraria, *Kützing* (*fide* James Groves). A new record for this species for H. C. Watson's county No. 111 Orkney.

Chara contraria, *Kützing, var. b.* hispidula, *Braun.* (*fide* James Groves).—Mud at bottom of water, 3 inches deep, in a pool, 62 feet above sea-level, The Loons, Birsay,

Mainland, 1st October 1921, H. H. Johnston. Native. Common. Plants wholly submerged in water. A new record for this variety for H. C. Watson's county No. 111 Orkney.

Note on Juvenile Characters in Root and Stem Cuttings of Acanthus montanus. By L. B. Stewart.

(Read 18th May 1922.)

Taking a root of Acanthus about a foot long, dividing it into portions of from 3 to 4 inches, and placing these in a propagating case, it is found that the portion with the root apex attached continues to elongate, while the other portions generally develop side roots near the basal ends. In root cuttings of Acanthus there is always a tendency on the part of the cutting to produce more roots to begin with than there is for shoot production. On the meristematic tissue at the upper ends of each portion buds are formed of which one or two produce growth shoots, the remaining buds lying dormant. Seldom are more than two growth shoots sent up. Should three or four growths start away they have very short internodes and are weak in growth. The dormant buds remain fresh and green for two or three years and are ultimately overgrown by the growth shoots. Should, however, the growth shoots be knocked off or be cut off, one or more of the dormant buds will produce growth shoots.

The appearance of the growth developed from the three portions of root show marked contrasts. The shoot developed from the youngest piece of root which bears the root apex is juvenile in character whereas the growth formed on the oldest portion shows much more adult characters.

Bud formation on the normally lower end of the root portion is more difficult to induce, but this can be accomplished by inserting the portion of root first in the normal position until callus has formed, then by inverting the cutting and at the same time giving the callus a wound stimulus, buds are thereafter formed. Buds formed on the

inverted cutting are not so numerous as are the buds formed on the normally placed cutting. Even after a growth shoot has developed from the normally basal end of an inverted cutting it will often be found that roots are produced from the base of this growth shoot. If these roots are allowed to develop the growth shoot soon disconnects itself from the parent cutting. The remaining buds on the inverted cutting are somewhat difficult to start into growth, but this can be done by hot water stimulation.

On the inverted cutting the growth shoots exhibit very juvenile characters and the leaves are miniature. Such leaves are rarely seen even on seedlings unless the seeds are small and weak. Further, the growth on the inverted cutting takes a longer time to pass through the transitional stages to the adult form.

In stem cuttings the same gradation in growth forms from juvenile to adult character is seen. A stem cutting, consisting of the terminal portion of the plant when rooted, goes on growing without showing any change in form. On an internodal cutting with one bud in the leaf axil the growth produced shows a juvenile form, while the growth from an internode with no preformed buds left adhering shows a very markedly juvenile growth form. All juvenile forms again show marked similarity to seedlings.

OBITUARY NOTICE.

William Carruthers, 1830–1922.

The recent death of a Fellow of this Society elected so long ago as 1858 merits some notice, especially as he took an active part in the development of modern British botany. William Carruthers was born at Moffat, 29th May 1830, and he died 2nd June last, a record even for the proverbially long-lived botanist. After early education at Moffat Academy, he entered the University of Edinburgh in 1845, and, like many another student, a slender income needed to be supplemented by tutorial work, so we find

him still a student in 1854. In that year he joined New College, Edinburgh, to study for the ministry, and he must have shown exceptional ability in natural science, as John Fleming, Professor of Natural Science in that college, advised him to specialise in science. A period of further study under John Hutton Balfour, George Allman, and John Goodsir made him a possible successor to Dr. Fleming in 1858 when John Anderson was elected to the chair in New College. Forty-five years later Mr. Carruthers was appointed to discharge the duties of the Chair of Natural Science at New College during the session 1903–1904. After a short period as Lecturer in Botany at the New Veterinary College, Edinburgh, and Assistant Secretary to the Royal Society of Edinburgh, Mr. Carruthers joined the staff of the British Museum in 1859, thus reaching his life's work. From this time onwards his sphere was in London, but in 1879 he was a candidate for the Chair of Botany in Edinburgh, when Professor Dickson was appointed.

A brief review of the work of William Carruthers has more than a personal interest, for he was active during a period when botany in Britain passed through great developments. During his time notable advances were made in fossil botany, and in this field Carruthers was amongst the pioneers. His geological investigations occupy many papers, beginning with discoveries of new Dumfriesshire Graptolites in 1858, and a description of the geology of Moffat in 1859, both published by the Royal Physical Society of Edinburgh. The Transactions of the Botanical Society include in 1866 his important paper on *Lepidodendron* and *Calamites*. A more important contribution from our present standpoint is that "On Fossil Cycadean Stems from the Secondary Rocks of Britain," in the Transactions of the Linnean Society of London in 1870. Amongst these the description of the vegetative organs and fructifications of *Bennettites* established a group which has become an important link in the early ancestry of plants. Recognition of this and later work followed, and amongst other honours he was elected Fellow of the Linnean Society in 1861, and president from 1886 to 1890; Fellow of the Royal Society in 1871; president of the Geologists Asso-

ciation of London in 1875–76; president of the Biological Section of the British Association in 1886; Ph.D. of Upsala University, conferred at the bicentenary celebration of the birth of Linnaeus in 1907.

As administrator in the British Museum, the work of William Carruthers is perhaps less widely known, but none the less important. He joined that institution in 1859, as assistant when J. J. Bennett assumed the Keepership, vacant by the death of Robert Brown. The staff was Mr. Bennett and himself, and the department for botany was a small, crowded gallery in the Bloomsbury building. It was under these conditions that Carruthers did his research for the next ten years. His appointment as Keeper in 1871 brought him into a stormy period. A Royal Commission was then reviewing the position of scientific instruction in Britain, and botany at the British Museum came under severe criticism. The attack came from two sides; from Kew, which claimed a monopoly of collections, museums, and libraries, and from the teaching colleges of London. The result was that the British Museum department remained and the Keeper proceeded to develop its activities. Botany, with Zoology and Geology, was transferred in 1881 to the new Natural History Museum in Cromwell Road, and enlarged accommodation meant extension and arrangement of the exhibits. A library was also established, and as recorded later by one of his colleagues: "Mr. Carruthers' knowledge and appreciation of botanical literature was exercised to such admirable effect that it may be doubted whether a finer botanical library exists." Recognising the importance of cryptogamic botany, Mr. Carruthers laid the foundation of the present collections with the assistance of Henry Trimen and George Murray. A further encouragement was the publication of Crombie's "Enumeration of British Lichens," and Lister's "Monograph of Mycetozoa." When Mr. Carruthers retired in 1895 his staff consisted of five assistants in place of one in 1859.

Agricultural botany was another development, and Mr. Carruthers has left the history of this in the Journal of the Royal Agricultural Society (vol. lxx, 1909). Fifty years ago there was no organisation whereby farmers

could ascertain whether seeds were good or bad. The Royal Agricultural Society consulted with Mr. Carruthers, with the result that he became consulting botanist to the Society and retained this post for thirty-eight years. By 1883 several of the larger seed firms began to give guarantees of purity and germination, and through the agricultural societies these could be checked by an impartial test. The seed-testing stations arose from this beginning, so that now no farmer need purchase bad seed. Another great change was the increased attention given to "natural" grasses suitable for meadows and pastures. Mr. Carruthers has thus taken an important part in developments of great consequence to agriculture. He has seen his forecasts confirmed and brought into the ordinary practice of a fraternity, the farmers, who are not too easy to move. Weeds, injurious plants, and parasitic fungi also came within the scope of his work as consulting botanist, and all agricultural botanists must acknowledge the usefulness of his reports and observations.

It is not without interest in the career of a public servant to see the man himself. William Carruthers had another side. The "British Weekly," in a lengthy obituary, refers to him as "one of a band of zealous elders of the English Presbyterian Church," who took an active part in Church organisation, including a union of the two branches of that Church in England. He edited the "Children's Messenger" for forty-two years, thus demonstrating by actual labour his interest in his Church. He was also keenly interested in Puritan history and biography.

Personally I cannot add much, but there was an occasion when a student, returning from a period of study abroad, invaded the British Museum and received a cordial welcome from the Keeper, who along with Mr. George Murray gave every facility for reference to the cryptogamic collections of the Museum. This, I believe, represents the experience of all botanists who sought the assistance of William Carruthers.

WILLIAM G. SMITH.

Notes on Chinese Lilies. By Professor William Wright Smith. (With Pls. IV.–VII.)

The following notes have been rendered possible by the kindness of Professor Henri Lecomte, Director of the Herbarium of the Paris Museum, who has given me the opportunity of examining the type specimens of the species of Lilium described by the late M. Franchet. The bulk of the material otherwise available was collected by Mr. George Forrest during his various explorations in Yunnan and Western Szechwan. This has been supplemented by collections of other travellers and especially by the acquisition of the Chinese Herbarium of the late Monseigneur Léveillé, containing types of many imperfectly known plants described by him. The necessary data in herbaria and in gardens on which to found an adequate account of the Chinese Lilies as a whole are still far from complete, and the present notes deal for the most part with species for which recently acquired material has served as a basis for ampler description and possibly more precise definition. The material is rich in collections from Western China, but the species of Northern and Eastern China are comparatively poorly represented. These notes will consequently refer chiefly to the western species. I have taken certain well-marked western species as subordinate centres round which to arrange what seems to me to be their near allies. I have had an opportunity of discussing the Yunnan species very fully with Mr. George Forrest, who has returned again to that province for further exploration. He has been kind enough to say that he will make observations on the western species in their natural state, and try to solve some of the difficulties which presented themselves both to him and to me. I have also had the privilege of discussing most of the species with the late Mr. H. J. Elwes, F.R.S., the monographer of the genus, with Mr. A. Grove, and also with Mr. E. H. Wilson, Assistant-Director of the Arnold Arboretum, the well-known Chinese explorer whose writings are familiar to all interested in the genus.

It would perhaps be too much to expect that in such a critical group as the Lilies we should all be in accord as regards our views, but I think I may safely say that our points of agreement are many and our points of disagreement comparatively few. The present notes express the views taken by Mr. Forrest and myself on the species we have ventured to discuss. The abundant literature on the genus Lilium is almost in itself an index of the numerous difficulties botanists have found in coming to definite conclusions regarding the distinctness of the individual species. The Chinese Lilies are no exception, and present many difficulties. The number of species described has increased very considerably since 1884 when Mr. Elwes, at the International Botanical Congress at St. Petersburg, cited only ten species, of which three were doubtful, as being indigenous to China and Tibet. Franchet in his paper (Journal de Botanique, vi, 1892, p. 305) on the Lilies of China and Tibet in the herbarium of the Paris Museum more than doubled that number. And since 1892 many more have been added. In his paper Franchet gives a key to the Chinese species, as understood by him, and lays stress on the character of the nectariferous furrow. I have found that character of the greatest service. He gives also two warnings which are worthy of repetition. The first deals with the original description of the Chinese and Japanese Lilies:—

"L'étude des espèces du genre Lis a été rendue très difficile, au moins pour celles qui sont d'origine chinoise ou japonaise, par la multiplicité de leurs formes dans les cultures. En effet, contrairement à ce qui se passe d'ordinaire, où l'on voit les formes spontanées décrites les premières, c'est-à-dire avant toute modification due à l'intervention de l'homme, il est arrivé que beaucoup de Lis ont été décrits d'après des individus cultivés; ces Lis sont, pour la plupart, réellement originaires de la région qu'on leur assigne pour patrie, mais ils ont été presque tous trouvés par les importateurs dans les jardins, où ils avaient préalablement subi des modifications plus ou moins profondes. Or on sait que les jardiniers chinois et japonais sont passé maîtres dans l'art de transformer les plantes."

When Franchet wrote the above he had no doubt in mind the Lilies of Japan and the maritime provinces of China, but from the explorations of Wilson and of Forrest we know that some of the indigenous species of Western China have been cultivated for many generations as an article of food Cultivation in such extensive provinces as Szechwan and Yunnan with their great divergences in climate has no doubt tended to produce cultural races in the species used for food. Franchet's caveat must therefore be borne in mind in all questions dealing with the delimitation of the species of the area.

My second extract from Franchet is as follows:—

"Mais comme, en même temps, tous les groupements des espèces de Lis ont pour base cette forme du périanthe, il en résulte de sérieuses difficultés lorsqu'il faut comparer une forme cultivée avec son type spontané, ou ce que l'on considère comme tel. La difficulté est encore augmentée par ce fait que la direction dressée ou révolutée des divisions du périanthe ne se manifeste complètement que tardivement et, en général, seulement après le fécondation."

Baker's division of the known Lilies into five groups (Journ. Linn., Soc. xiv (1875), p. 225) affords a useful conspectus of the species, but all who have dealt with the genus know that there are several species which seem to hover between two groups and even form a transition from one to the other. I think it therefore apposite to recall Franchet's words.

Another element of complexity is introduced by the peculiar geographical conditions of Western Yunnan and to a certain extent of Szechwan. Recent work on the flora of these regions tends to show that there are several quite distinct geographical areas in these regions and that what at first appear to be conspecific plants in adjoining areas show, after investigation, differences which are not far from specific. Yunnan, owing to the peculiarities of its natural features, appears to be rich in geographical races. This separation of areas seems to me to be due in great part to the depth of the valley floor separating one mountain range from another. In a great number of these Yunnan valleys the floor descends to an elevation little

above sea-level. The ranges are consequently separated in some cases by a sub-arid tropical region, in others by a moist valley with dense tropical vegetation. Such a configuration induces isolated botanical regions with resultant specific divergences in many genera. As Professor Sir Isaac Bayley Balfour pointed out to me, this may not affect Lilium and allied bulbous genera to the same extent as other genera which are more responsive to edaphic conditions.

The first group I propose to discuss is that which centres round *Lilium taliense*, Franchet.

I.

Lilium taliense, Franchet, and its Allies.

Among the Asiatic Martagons this species and its near allies are well defined by the nectariferous furrow being without papillae, and consequently smooth and naked. As Franchet pointed out (Journ. de Bot., vi, p. 320, 1892), the Asiatic species having this peculiarity are *L. speciosum, ochraceum, taliense,* and *polyphyllum*. *L. speciosum* (one of the Archelirions) has no affinity with *taliense*, and I need not discuss it here. *L. polyphyllum* is apparently confined to the Western Himalaya, and in its bulb and other characters is readily distinguished from the Chinese members of this alliance. In China, therefore, we are concerned in the first place with Franchet's two species, *L. ochraceum* and *L. taliense*. But since Franchet's time there have been additions. Léveillé has described five lilies of this series from Yunnan and Kweichow—*L. Bodinieri, L. Feddei, L. majoense, L. Pyi,* and *L. Tenii*. Of these the Edinburgh herbarium now possesses the types with the exception of that of *L. Pyi*, which is unfortunately absent from Léveillé's collection. Of it I can therefore say nothing but that Léveillé places it near *L. concolor* of the Isolirions, while his description suggests a Martagon. *L. nepalense*, D. Don, must also be considered in this connection as it has been held, and with some reason, that *L. ochraceum* is only a form of that Himalayan plant. The admission of *L. nepalense* for discussion in the series implies also an examination of *L. primulinum*,

Baker. There is also an addition to the series which will be described later in this paper, *L. Stewartianum*, Balf. f. et W. W. Sm., a very pretty, dwarfish Martagon, with solitary flowers, allied closely to *L. taliense*.

Of *L. taliense* several gatherings were made by Forrest. One of these, No. 7022, comes from the eastern flank of the Tali Range quite near to the area from which Delavay collected the type. I have compared this Tali Range plant of Forrest with Delavay's type and it agrees exactly. Forrest describes his plants as from 2½–5 feet high with the flowers pure white, spotted maroon, and fragrant. It occurs amongst open and mixed scrub. Conspecific with this is Forrest 2716 from the eastern flank of the Lichiang Range, growing in open, shady, situations in mixed forests. Forrest describes the plant as 4–8 feet high, the flowers being pure waxy white, spotted purplish-lake, and fragrant. The inflorescence has as many as seven flowers and is more robust than Franchet's type with only one or two. Still more robust is a plant collected by Forrest in the same locality under No. 6152. Forrest describes this as from 4–10 feet high, with fragrant, white flowers, spotted crimson. One of the specimens shows ten flowers. Forrest also collected a plant under No. 10,473 in the mountains in the north-east of the Yangtze Bend. The white, fragrant flowers are spotted purple, and the plant is 4–5 feet high. The specimen of this number in the Edinburgh herbarium bears eleven flowers. Beyond differences in vigour these specimens show practically no divergence from the type. In Franchet's key (J. de Bot., vol. vi, p. 309) *taliense* is given with "fleurs purpurines," but in his description, p. 319, it is "albidi." The latter is correct.

As *L. Stewartianum*, Balf, f. et W. W. Sm., is closely akin it will be convenient to discuss it here. Forrest found the type of this species in July 1913 on the mountains on the north-east of the Yangtze Bend, No. 10,647. The flowers are of a deep olive-yellow, but almost black with deep crimson-maroon markings, and fragrant. This plant he found again in July 1914 on the Chungtien Plateau at 12,000 feet, No. 12,734. In July 1913 he also discovered on the north-west of the Lichiang Range a

lighter coloured form, No. 10,659, which is undoubtedly conspecific. He described the flower of the last as greenish-yellow, profusely spotted maroon. The species is readily distinguished from *L. taliense* by the smooth stem and by the solitary flowers—of the fifteen plants collected all have solitary flowers. From *L. ochraceum* the long, grass-like leaves give an easy means of distinction. A detailed description is appended. (See also Pl. IV.)

Lilium Stewartianum, Balf. f. et W. W. Sm. Sp. nov. Species sectionis Martagon et affinis *L. ochraceo*, Franch. et *L. taliensi*, Franch.; ab hoc habitu graciliore, caulibus glabris laevibusque, floribus semper solitariis flavidis differt; ab illo habitu graciliore, foliis gramineis, floribus solitariis inter alia recedit.

Planta 45–50 cm. alta ex collectore. Bulbus circ. 2–3 cm. longus, ovatus, squamis ovato-lanceolatis tenuibus in sicco flavidis, radicibus basi sat bene evolutis. Caulis erectus glaber epapillosus; pars hypogaea 5–8 cm. longa haud repens radicibus destituta; pars epigaea basi nuda mox foliis bene vestita. Folia plus minusve 20, erecta et vix patentia, 5–8 cm. longa, circ. 2 mm. lata, acuta, ad insertionem vix angustata, omnia sparsa, plana, tantum sub lente valida margine scabridiuscula, glabra; infima nonnunquam breviora et ad 5 mm. lata; supremum saepe ad basim floris solitarii attingens. Pedunculus 6–7 cm. longus flore nutante fragrante. Perianthii pars tertia tubulosa; segmenta subrevoluta, fere 4 cm. longa, medio circ. 9 mm. lata, oblonga, obtusiuscula, saturate olivaceo-flava, maculis atrokermesinis densissime ornata; sulcus nectariferus nudus glaber. Staminum filamenta 2·5 cm. longa, glabra; antherae 8–9 mm. longae, in sicco brunneae. Stylus in flore bene evoluto dissecto tantum 1 cm. longus ovario 1·5 cm. longo brevior, nonnumquam ovarium subaequans, certe duplo vel triplo haud superans ut apud *L. taliense* vel *L. ochraceum*. Fructus deest.

"West China—Mountains in the N.E. of the Yangtze Bend, Yunnan, on open stony pasture. Lat. 27° 45′ N. Alt. 11,000 feet. Plant of 18–20 inches. Flowers, ground-colour deep olive-yellow, but almost black with deep crimson-maroon markings, fragrant. July 1913." G. Forrest. No. 10,647.

"Mountains of the Chungtien plateau. Lat. 27° 30′ N. Alt. 12,000. July 1914. Duplicate of 1913." G. Forrest. No. 12,734.

The following with less darkly spotted perianth is the same species.

"West China.—N.W. flank of the Lichiang Range, Yunnan, on ledges of limestone cliffs and stony pasture. Lat. 27° 35′ N. Alt. 12,000 feet. Plant of 2 feet. Flowers greenish-yellow, profusely spotted maroon, fragrant. July 1913." G. Forrest. No. 10,659.

I come now to *L. ochraceum*. There has been much confusion regarding this species. The identification of species from W. Yunnan and Northern Burma is involved in many cases owing to the fact that Franchet described so many plants from the standpoint of the Paris herbarium, while others from the same area were described from the standpoint of Indian and Burmese collections in the herbaria of Kew, Calcutta, and the British Museum. Paris lacks reliable sheets of many Indian species, while, conversely, in this country authentic representations of many of Franchet's species are unavailable. This is obvious in many genera besides *Lilium*. In the present instance *L. nepalense*, D. Don, is the plant from which *L. ochraceum* can only with some difficulty be distinguished. In his diagnosis of *L. ochraceum*, Franchet makes no reference to *L. nepalense*. This was hardly to be expected as Franchet dealt with *ochraceum* as a lily with its perianth segments completely recurved at the end of anthesis—that is, he treated it as a Martagon in the strict sense. We shall see whether Franchet was justified in his assumption. *L. nepalense* has since been recorded from both Yunnan and Northern Burma. The first Burma record (Collett and Hemsl. in Journ. Linn. Soc., vol. xxviii, p. 138) was later seen to be an error and the plant identified as *L. nepalense* was subsequently named *L. Lowii*, Baker (Bot. Mag., tab. 7232). *L. primulinum* on its discovery in Upper Burma was referred first of all to *L. neilgherrense* and its affinity with *L. nepalense* was not suggested. But in addition to these there is undoubtedly to be found in Upper Burma and on the Chinese-Burmese frontier a lily almost indistinguishable, perhaps indistinguishable, from *L. nepalense*.

Mr. Farrer collected it on Hpimaw Hill in full flower in July 1919, and in the same month Mr. Forrest got it on the N'mai-kha Salween divide in Yunnan. I have no doubt that bulbs of this plant have reached this country more than once within the last thirty years. Along with it no doubt were imported bulbs of *primulinum* and *Lowii* as well as of a plant[1] closely resembling *neilgherrense* and *Wallichianum*. Perhaps mixing of these bulbs gives the reason for the confusion of such plants as *neilgherrense*, *Lowii*, and *nepalense*, which have little in common. The record in the horticultural journals supports this statement. In the "Garden" for 6th October 1900 I find the following:—

"When Upper Burmah was first opened up by our military authorities a great many bulbs of *Lilium nepalense* were sent to this country, but of late this lily has not been so plentiful."

In the "Garden" for 12th October 1895:—

"It is certainly a very distinct lily, and though the flowers are beautiful, it is not at all likely that it will become a popular lily as it often runs up tall and weak, and is after the first season not very amenable to cultivation. The additional numbers seen this year may, I think, be attributed to the fact that a few large importations came to this country in the spring, and one at least of considerably over 1000 bulbs was disposed of at the London auction rooms as mixed species from the Shan States of Upper Burmah. These seem, however, to be nearly all *L. nepalense*, at least as far as I have seen them in flower. There is a certain amount of variation to be found in the flowers of this lily, as in some the chocolate at the basal half of the petals extends much farther down than others, while the greenish-yellow of the rest of the flower also varies in hue."

I call attention to this note particularly as the behaviour of *L. ochraceum* in the garden is quite another story. There are other references giving Burma as a habitat, and

[1] Possibly *L. myriophyllum*, Franch., and certainly *L. sulphureum*, Baker, were included in these bulb collections, but these two are probably one and the same species.

all appear to agree that *nepalense* is rather a difficult lily to cultivate. Mr. Grove in his book on Lilies (p. 34) indicates the same opinion:—

"As grown in temperate houses in this country the Lily is not so beautiful as many, and the distinct suspicion of green in the yellow of the flower, which one may notice sometimes in certain of the Narcissi, somehow conveys the impression that the plant needs more sun to develop the true colours."

The Chinese record of the occurrence of *nepalense* (C. H. Wright in Jour. Linn. Soc., vol. xxxvi, p. 133), quotes Henry 9230 and Hancock 392, but is qualified by the statement that *nepalense* is a species with numerous forms. *L. ochraceum* and the Yunnan plants which have been identified as *L. nepalense* in the above record have a wide range in that province. They occur in the Tali and Lichiang ranges, on the Tengyueh side of the province, and also in the much drier eastern part of the province near Yunnan-sen, extending from there into Kweichow. This gives a considerable variation of habitat starting from the drier eastern Yunnan, passing through the moderately wet Tali and Lichiang areas and ending in the wetter Tengyueh and Upper Burma zone. The plants of the latter area are the ones which approximate most to the Nepal plant. The changes in the character of this lily vary as the course is taken westwards. In the drier Chinese areas we start with a definite Martagon Lily, sometimes dwarf, but not necessarily so. The leaves of the plant of the dry area are usually narrow, often "one-nerved," often very numerous, and as I have noticed both on the dried specimens and in cultivation, frequently of very firm consistency and somewhat curved and twisted. Some of these characters are obviously a response to environment. At the other end of the scale we have the Central Himalayan plant, an Archelirion, with usually thinnish leaves, and these are more or less distinctly 5–7-nerved. The Burmese and frontier specimens are intermediate, inclining most perhaps towards *nepalense* itself. Before we go farther it might be well to inquire whether Franchet was right in assuming *ochraceum* to be of the Martagon type.

L. ochraceum has been in cultivation for the last five years in the Royal Botanic Garden here. At first it did not do particularly well, but in 1920 it came up very strongly and flowered freely. During the five years it has been kept in a comparatively exposed position in the Rock Garden and has received no special attention. The flowers on the first two days of opening tended to keep a trumpet shape, but rapidly after that the perianth segments were completely recurved to as full a Martagon shape as anyone would wish. The leaves were 1–3-nerved, were numerous, and showed a firm consistency with a tendency to twist. Mr. Grove sent me a photograph of a specimen he had some years ago under the name of *L. ochraceum*, showing the early stages of anthesis. He tells me that he thought little of the plant, at that time considering it as a very poor form of *nepalense* and not worth keeping. In his photograph the crowded, twisted leaves are particularly noticeable.

We are now faced with the problem as to whether it is possible to regard this whole series as one species. If I interpret him aright, Mr. Wilson inclines to this view. I admit that I have not, so far, found myself able to draw a dividing line, but, though that may be inconsistent, I cannot reconcile myself to regarding the whole as a unit. Franchet's dry-region Lily is one thing botanically and horticulturally, and the Nepal Lily is another. The Burmese plants certainly form a bridge between the two.

Before going farther, I wish to contrast various specimens with Franchet's type of *ochraceum*. Franchet's type was the plant collected by Delavay at the foot of the Tchang-chan, at an altitude of 3000 metres. I am informed by Mr. Forrest that Delavay's Tchang-chan is the Tali Range quite close to the town of Tali. The flowers of the type are said to be yellow and unspotted. I take Forrest No. 4813, collected on the margins of open and mixed forests on the eastern flank of the Tali Range to be identical with the Paris type. Forrest describes the specimen as a plant of 2–6 feet with fragrant flowers, olive-brown and purple. The purple does not appear in spots, but diffused through the lower inside part of the perianth. The type shows the same colouring. In the Lichiang Range in dry situations

amongst scrub, Forrest found a lily, No. 2869, with olive-yellow flowers, veined and edged maroon; some of the upper leaves are 3-nerved, while the stem is "levissimus" except at the very base. This is obviously conspecific. So also is No. 6465 from the eastern flank of the Lichiang Range, greenish-yellow flowers with crimson markings; also No. 10,879 from the Tong Shan in the Yangtze Bend, a plant of 5 feet, flowers yellow with maroon markings. The two last cited collections have longer and more membranous leaves than the first two and the type. In their shape and consistency they closely approach those of typical *nepalense*.

The above come from a fairly well defined geographical area. The next two show a divergence. They come from the south-west of Yunnan, one from the neighbourhood of Tengyueh from a lava-bed (No. 8930), and one from the Tai-ping-Irrawadi Divide (No. 9080). They are not identical with one another, and neither of them with the type. They exceed the type in robustness. No. 8930 attains 9 feet, according to Mr. Forrest. The flowers are dull greenish-yellow, interior base deep crimson-maroon, and are fragrant as those of the typical series. The chief difficulty is in the papillose scabridity of the stem throughout its whole length. Typical *ochraceum* has the stem "levissimus." The papillose scabridity is present only at the very base of the stem in certain of the plants which I have admitted above as equivalent to Franchet's type. Is this scabridity to be correlated with vigour of growth? In view of the general agreement in other characters, I do not feel justified in giving even a varietal name to this form.

No. 9080 is a stout plant attaining, it is true, only 4 feet, according to Mr. Forrest, but showing very much larger and broader leaves in the upper half and also larger flowers. These Mr. Forrest records as olive-yellow and maroon, and states that they are non-fragrant. The bulb is that of *L. ochraceum* and likewise the leaves in the lower half of the stem. The scabridity is that of No. 8930, though scarcely so pronounced. The upper leaves attain 4 inches and are 3-nerved; the leafy bracts of the inflorescence are quite $\frac{3}{4}$-inch wide and 5-nerved or even

7-nerved. The inflorescence is anything from 1- to 7-flowered. Here is a plant which in the bud condition and also in the flower might well invite confusion with *L. nepalense*. The perianth is recurved from the lower third and is that of a Martagon. The plant has the characteristics which one might expect in a lily of the dry region transferred to a region more influenced by the monsoon rains.

Coming farther west to Upper Burma and the Chinese-Burmese frontier, I find the series represented by three separate gatherings. Forrest collected under No. 18,280, in July 1919, a lily 4–5 feet high with fragrant, olive-yellow flowers, the interior and exterior flushed deep purple. The leaves are of thin texture, very long and narrow, almost grass-like, the stem somewhat scabrid, the perianth large with the segments recurved from below the middle. The second specimen, collected by Forrest under No. 18,378 from the Mekong-Salween Divide, has perfectly smooth stems, very long, thin, narrowly-lanceolate leaves, and fragrant, dull olive-yellow flowers. The third specimen was collected by the late Mr. Farrer on Hpimaw Hill and he, without hesitation, labelled it *nepalense*. Under his No. 1122, he states that it is "common on the open slopes of Hpimaw Hill. The flowers are clear yellow, sweetly scented, with brown-purple centre. It attains 7 feet and handsomely emerges from amidst the bracken." His specimen has long, narrowly-lanceolate leaves of firm consistency, 3–5 nerved, with a flower almost the recorded size of *L. nepalense*, and the perianth segments appear to be recurved from about the middle; the stem is perfectly smooth and shiny. The collection of these three specimens from practically the same area is sufficient to show that we have to deal with a very variable plant and that to suggest names for all these variations is quite unnecessary. The Burman plant collected by Mr. Farrer I cannot distinguish from the Central Himalayan by any distinct character. I have recently had an opportunity of examining again the specimens of *L. nepalense* in the Kew herbarium. In the majority of these the leaves are long and flaccid, but in one of the specimens from Gossain-than, Nepal, the leaves are firm in texture and the flowers 5 inches long.

I now refer to plants collected by Henry at Mengtze Nos. 9320 and 9320A. The specimens in the herbaria of Kew and Edinburgh under these numbers agree with *ochraceum* in bulb, stem, leaf, and flower.

In eastern Yunnan, near Yunnan-sen, E. E. Maire collected a lily (No. 937 in Herb. Edin.) with this description: "Lys bronzé à l'intérieur, rouge sombre à l'extérieur, pétales en volutes extérieures: altitude 2350 m.; très rare." It has glabrous stems, short, crowded leaves of firm consistency, and small flowers with the segments completely recurved to the true Martagon form. It is *ochraceum* as one would expect it to occur in the drier east Yunnan.

Before attempting to sum up the evidence it might be well to look first at the species of this alliance described by Léveillé from eastern Yunnan and Kweichow.

L. Bodinieri, Lévl. MSS. in Herb. Lévl.—Léveillé later reduced his species, incorrectly, to *L. apertum*, Fr., and as such it appears in his Flore de Kouy-Tchéou. His specimens are all referable to the *ochraceum* of dry eastern Yunnan.

L. Feddei, Lévl. in Fedde Repert. Nov. Spec. xi (1912), 303.—Mr. Wilson, Mr. Forrest, and myself have examined the type together and agree that it is *taliense*. The range of this species is thus widened.

L. majoense, Lévl. in Fedde Repert. Nov. Spec. vi (1909), 265, is a form of *L. ochraceum*, Fr.—The flowers are in a very poor state of preservation, but agree exactly with those of *ochraceum*. Some of the leaves are quite typical; others, detached, are very long and flaccid with a very acuminate base.

There is also *L. Tenii*, Lévl. in Fedde Repert. Nov. Spec. vi (1909), p. 263.—This is a puzzling plant. The flowers are quite those of a small *ochraceum*. The leaves of the type are broadly-lanceolate with a very broad insertion, and lack entirely the attenuate-base characters of the whole *ochraceum-nepalense* series. Even in the many variations noted above in the series, I can find nothing quite like the leaves of *Tenii*. Another point, and one, too, noted by Léveillé, is the peculiar resupinate fruit. The fruiting specimens show the leaf-form perhaps even more markedly—some of the leaves having 9–11 distinct nerves.

On the evidence before me I cannot justify the reduction of this species, at any rate meanwhile, to any previously described species. It is a near ally of *ochraceum*. See Plates V., VI.

Of this alliance there remains to be considered only *L. primulinum*, Baker. I have no acquaintance with this species in cultivation, but a recent examination of the type leads me to consider it as a colour variant of the Burmese form of *L. nepalense*. The purplish blotching so characteristic of the rest of the series is here lacking. Like its Burmese relative it occupies an intermediate position between Eulirion and Martagon, as was pointed out by Baker in describing the species.

I shall now try to summarise the foregoing pages. I look upon *L. ochraceum*, Franch., as a good species of the Martagon group extending from the Tali and Lichiang Ranges eastwards towards Yunnan-sen, East Yunnan, and still farther to Kweichow. It also extends into the south-east in the neighbourhood of Szemao and Mengtze. In Eastern Yunnan there is the allied *L. Tenii*, Lévl. *L. ochraceum*, in the experience of the Royal Botanic Garden, Edinburgh, is a hardy lily. At the other extreme of the area of the series is the trumpet-shaped Nepal Lily confined in its typical form to the Central and North-West Himalaya. According to the uniform experience of cultivators this is not a hardy species. In the country running from Tengyueh over the Chino-Burmese frontier into Upper Burma we have a region of great variability of the series contrasting strongly with the comparative homogeneity of *ochraceum* and of *nepalense* in the other areas. The stem may be quite smooth to quite scabrid; the leaves may be linear and grass-like and of very thin consistency, or they may be long lanceolate and flaccid, or broadly and shortly lanceolate and of firm consistency; the flowers show a type of perianth intermediate between Martagon and Eulirion; they may be heavily blotched with purple or they may be quite unblotched as in *L. primulinum*. These variations do not appear restricted to any definite geographical area but intermingle. I doubt whether any of them can be called truly equivalent to the Nepal Lily. I suggest, therefore, the varietal appellation of *burmanicum*

to these variable Burmese plants, retaining also the name *L. primulinum* for the well-marked canary-yellow plant without blotches. The other species of the alliance, *polyphyllum*, *Stewartianum*, and *taliense* are comparatively easily discriminated from the foregoing and from each other.

I submit a key to the species discussed above.

KEY TO THE SPECIES.

I. Martagon type of perianth—completely revolute.	
* Flowers with white ground-colour.	*taliense*
** Flowers with yellow or greenish-yellow ground-colour.	
† Stems always 1-fld.	*Stewartianum*
†† Stems usually 2–10-fld.	
‡ West Himalayan species with narrow elongate bulb	*polyphyllum*
‡‡ Chinese Species.	
§ Leaves with cuneate base	*ochraceum*
§§ Leaves with rounded base; fruit small, resupinate	*Tenii*
II. Intermediate type of perianth between Martagon and Eulirion.	
* Flowers heavily blotched inside with purple	*nepalense* var. *burmanicum*
** Flowers canary-yellow, unblotched	*nepalense* var. *primulinum*
III. Archelirion-Eulirion type of perianth with segments spreading from the upper third	*nepalense* var. *typicum*

INDEX TO NAMES RELATING TO LILIUM TALIENSE AND ITS ALLIES.

Lilium apertum, Lévl. in Flore de Kouy-Tchéou, p. 25, nec Franch. =*ochraceum*.

L. Bodinieri, Lévl. MSS. in Herb. Lévl. =*ochraceum*.

L. claptonense, Hort. Low. =*primulinum*.

L. Feddei, Lévl. in Fedde Repert. Nov. Spec. xi (1912) 303. =*taliense*.

L. majoense, Lévl. in Fedde Repert. Nov. Spec. vi (1909), 265. =*ochraceum*.

L. neilgherrense, Collet. & Hemsl. in Jour. Linn. Soc., xxviii (1891), 138, nec Wight. =*primulinum*.

L. nepalense, D. Don in Trans. Wern. Soc., iii (1821), 412. North-West and Central Himalaya.

var. **burmanicum**, W. W. Sm. Upper Burma and Burmo-Yunnan frontier.

var. **primulinum** (Baker). Upper Burma.

L. ochraceum, Franch. in Journ. de Bot., vi (1892), 319. Yunnan, Kweichow.

L. ochroleucum, Wall. MSS. in Herb. Lindl. =*nepalense*.

L. polyphyllum, D. Don in Royle's Ill. Him. (1839), 388. Western Himalaya.

L. primulinum, Baker in Bot. Mag., vol. cxviii (1892), t. 7227. = *nepalense* var. *primulinum*.

L. punctatum, Jacquem. MSS. ex Duchart. Obs. Gen. Lis., 77. = *polyphyllum*.

L. Pyi, Lévl. in Fedde Repert. Nov. Spec. vi (1909), 263. Imperfectly known and altogether doubtful. East Yunnan.

L. Stewartianum, Balf. f. et W. W. Sm. in Trans. Bot. Soc. Edin., xxviii, pt. 3 (1922), 127. West Yunnan.

L. stylosum, Klotzsch. MSS. in Herb. Berol. =*polyphyllum*.

L. taliense, Franch. in Journ. de Bot., vi (1892), 319. Yunnan.

L. Tenii, Lévl. in Fedde Repert. Nov. Spec. vi. (1909), 263. East Yunnan.

II.

The Lilies in Herb. Léveillé.

The following notes deal with the material used by Monseigneur Léveillé for description of his new species and for record of occurrence of previously known species in his floras of Yunnan and Kweichow. Some of it is of very poor quality and does not afford a basis for definite determination. I omit reference to plants in the collection, some correctly named, others not, which have no bearing on the validity of species or on the distribution of the Chinese Lily flora. For purposes of reference I deal with the names in alphabetical order.

L. apertum, Lévl. in Fl. de Kouy-Tchéou, p. 250, nec Franch. E. E. Maire, No. 7454 in Herb. Bonati; pasture land, Tong Tchouan, East Yunnan, 2800 m.

Cavalerie, No. 3006; Majo, Gan-chouen, Kweichow.

This is the basis for record of *L. apertum* in Kweichow. (Flore de Kouy-Tchéou, p. 250.)

All referable to *L. ochraceum*, Franch.

L. Bodinieri, Lévl. in Herb. Lévl.

Type, Cavalerie, No. 3006. See under *apertum*. Léveillé reduced his species to *L. apertum*, Franch. I have found no record of publication of the name.

L. Bonatii, Lévl. in Fedde Repert. Nov. Spec. xi. (1912–13), p. 303.

Type, Maire, No. 7336 in Herb. Bonati. Also collected by Maire at Io-chan and Ta-hai, East Yunnan at 3200–3400 m.

The plant is *Fritillaria cirrhosa*, D. Don.

L. callosum, Sieb. et Zucc. Fl. Jap., p. 86, t. 41.

This is recorded as such in Flore de Kouy-Tchéou, p. 250.

Coll. Emile Bodinier, No. 2440. Environs de Kouy-yang. Bords du ruisseau au bas de la mont de Kien-lin-chan. Fleurs jaune-rouge.

The plant is *L. Henryi*, Baker, which thus extends into Kweichow.

L. Cavaleriei, Lévl. et Vaniot in Mem. Acc. Nuovi Lincei, Roma, xxiii (1905), 372. This is a puzzling fragment. The material consists of one detached flower and a small portion of stem with three leaves, two of these adjoining the inflorescence region. Léveillé's description is too short, and he suggests an affinity with his *L. linceorum*, q.v. It has no connection with that plant. I append the original description:—

"*Lilium Cavaleriei*, Lévl. et Vnt. Sp. nov.

"Differt a praecedente foliis multo rarioribus, longioribus et latioribus, praesertimque flore luteo et profunde lateque aperto, stylo et staminibus perianthio ferme aequalibus.

"Kouy-Tchéou: Gan-pin (Julien Cavalerie)."

In his Flore de Kouy-Tchéou, the record of this lily is subscribed "Sans localité ni indication."

Along with the specimen is a short note forwarded by the original correspondent to Léveillé—by Cavalerie, I presume, although this is not certain.

"Cette fleur est pour vous dire que le lys sec n'est pas le même—ce jaune est je crois assez commun; le rouge que je vous envoie est moins—du moins par ici. Le rouge ne s'ouvre pas non plus de cette façon—il reste un peu fermé et retombe en cloche."

The red lily, I take it, is his *L. linceorum*—

type collected at Gan-pin by Emile Bodinier and L. Martin, No. 1681. It is said to be less common while the odd fragment is fairly so. Mr. E. H. Wilson is of opinion that the latter represents nothing more than a vigorous condition of *L. Davidi*, Duchart. With his opinion I concur.

L. concolor, Salisb. Parad. t. 47, and var. **pulchellum.**

Recorded by Léveillé for Yunnan in Plantes du Yunnan, p. 165.

The plants on which the record is based are *L. Delavayi*, Franch, but see under *L. Mairei.*

L. cupreum, Lévl. in Bull. de Geog. Bot., xxv. (1915), 38.

This is *L. Fargesii*, Franch., not previously recorded from Yunnan. One gathering of E. E. Maire from Ta-choui-tsin, E. Yunnan.

L. Fauriei, Lévl. et Vant. in Fedde Repert. Nov. Spec. v. (1908), 282.

Founded on Faurie Nos. 653 and 2100 in Herb. Lévl. from Korea. The plant is *L. amabile*, Palibin.

L. Feddei, Lévl. in Fedde Repert. Nov. Spec. xi. (1912), 303.

This has been discussed previously under *L. taliense*; see above, p. 134. The plant is *L. taliense*, Franch. The colour of the flower on ticket and in original description is given as yellow, but the writing on the ticket is not Maire's. A second gathering from Io-chan with ticket in Maire's hand says white, spotted red.

L. graminifolium, Lévl. et Vant. in Fedde Repert. Nov. Spec. v. (1908), 283.

The type shows an inflorescence of four very immature flowers. Nakai in Flora Koreana (1911), 258, suggests reduction to *L. callosum*, Sieb. et Zucc., and quite correctly. The bracts show the characteristic callused tips and the unopened flowers are those of *callosum.*

L. linceorum, Lévl. et Vant. in Mem. Acc. Nuovi Lincei, Roma, xxiii. (1905), 371.

The type is Bodinier et Martin, No. 1681, from Gan-pin, Kweichow. There are in addition in Herb. Lévl. several gatherings under this name from E.

Yunnan. They are all referable to *L. Delavayi*, Franch.

L. longiflorum, Thunb. in Trans. Linn. Soc., ii. (1797), 333.

Léveillé records this species in Plantes du Yunnan. His specimens are *L. Brownii*, F. E. Br. var. *Colchesteri*, E. H. Wills. The record of the same species in Flore de Kouy-Tchéou is based on Bodinier, No. 1722, collected near Kouy-yang. This latter is *L. myriophyllum*, Franch.

L. Mairei, Lévl. in Fedde Repert. Nov. Spec. xi. (1912), 303.

A figure in Plantes du Yunnan, p. 166, shows all there is of the type. It does not appear to be anything more than a poor form of *L. concolor*, Salisb.

L. majoense, Lévl. in Fedde Repert. Nov. Spec. vi. (1909), 265.

This is referable to *L. ochraceum*, Franch., and has been discussed under that species. See above, p. 134.

L. mirabile, Franch. in Journ. de Bot., vi. (1892), 313.

Represented in Herb. Lévl. by one gathering of Maire, at Lan-ngi-tsin, E. Yunnan. It accords with *L. mirabile* which is separable from *L. giganteum*, Wall., by characters of dubious value.

L. oxypetalum, Franch. in Journ. de Bot., vi. (1892), 320, nec Baker.

In Herb. Lévl. is a co-type (Delavay 4178). This is *L. apertum*, Franch. in Journ. de Bot., xii. (1898), 220, better referred to *Nomocharis* (see Trans. Bot. Soc. Edin., vol. xxvii. (1918), pp. 291, 296.

L. Pyi, Lévl. in Fedde Repert. Nov. Spec. vi. (1909), 263.

This lily is not in Herb. Léveillé, missing through some mischance. Léveillé places the plant near *L. concolor*, Salisb., but describes the flower as solitary and nodding, while the nectariferous furrow is glabrous; the perianth segments are recurved. The description rather suggests the affinity of *ochraceum* and *taliense*. In the absence of specimens the only course is to leave this as a dubious and imperfectly known species.

L. sempervivoideum, Lévl. in Bull. de Geog. Bot., xxv. (1915), 38.

This is figured in Plantes du Yunnan, p. 166.

Syn. *L. amoenum,* E. H. Wilson MSS. in Herb. Kew. on Henry, No. 10,743 and Hancock 174.

L. yunnanense, C. H. Wright, in Journ. Linn. Soc., xxxvi. (1903), 136, pro parte quoad spec. duo supra citata, vix Franch.

This is a dwarf lily of the Bakerianum-Delavayi group from the comparatively dry eastern Yunnan. Its relationships will be discussed when *L. Delavayi,* Franch., is dealt with (p. 159).

L. Taqueti, Lévl. et Vant. in Fedde Repert. Nov. Spec. v. (1908), 283.

This is represented by two stunted specimens less than a foot high, with unopened flower-buds—Taquet 2101. Nakai in Flora Koreana, p. 257, has suggested reduction to *L. cernuum,* Kom. Mr. Grove, Mr. Wilson, and I agree that the type represents a young stage of *L. callosum,* Sieb. et Zucc.

L. Tenii, Lévl. in Fedde Repert. Nov. Spec. vi. (1909), 263.

This plant has been referred to already in dealing with *L. ochraceum.* See above, p 134. The species is retained as possibly valid.

III.

L. Davidi, Franch., and its Allies.

There has been considerable discussion and confusion with regard to this lily and the species allied to it. Our knowledge of *L. Davidi* is based on very imperfect material. Its story will be found in Elwes' Monograph which contains the original description. The figure there was taken from what Mr. Elwes calls the single and not very perfect specimen. The author suggests that the colour of the lily flower may be brighter than the figure. The points in the description to which I would call attention particularly are :—

Stem slender, green spotted with purplish and covered with pubescent hairs; leaves 60–70, crowded towards the

centre of the stem, linear, having the edges revolute and a single prominent central nerve beneath covered with short hairs; flowers in the only known specimen 3, in colour apparently orange, with numerous purplish spots on their lower half; perianth segments shortly campanulate at the base, very spreading at the points, but not revolute, marked with prominent papillae at their base and remarkable for the presence on the upper side of a median band covered with long, white hairs. The bands are wider on the outer than on the inner segments, and form, in their junction at the base of the perianth, a downy collar.

Franchet in Plantae Davidianae, vol. ii (1888), p. 129, gives a further diagnosis, from which I would quote the following points:—

"Caulis ad apicem usque minutissime scaberulus . . . flores . . . lutei (ex icone citato) dense rubro-maculati.

"Espèce bien caractérisée par ses tiges finement scabres, ses feuilles étroites, allongées-graminiformes à bords repliés en dessous, par ses fleurs velues-papilleuses en dessous sur la nervure. Le *L. Davidi*, de même que l'espèce précédente, ne peuvent guère s'éloigner du *L. speciosum*, Thunb."

I note here that both Elwes and Franchet lay stress on the comparatively slight recurving of the perianth segments and on the remarkable development of hairs on the median line on the perianth segments. Elwes suggests no affinity, while Franchet is inclined to place it along with *L. Duchartrei* not far from *L. speciosum*, Thunb. Elwes is satisfied that the figure represents adequately the imperfect material available, and Franchet makes no suggestion that the same figure is unsatisfactory.

The next stage takes us to Franchet's review of the lilies of China and Tibet in Journ. de Bot., vi. (1892), 308. Here Franchet has gone very much farther into the distinguishing characters of the Chinese lilies. *L. speciosum* he puts aside on account of its glabrous nectariferous furrow. The others of the group we are concerned with he breaks up into three sections, which he endeavours to particularise by colour distinctions. In his first section with white or winey-red flowers he places *Duchartrei*, *papilliferum*, and *langkongense*. In the second section with yellow flowers,

spotted brown, he places *Davidi* and *Fargesii*. In the third section with orange-red or bright red flowers he places *sutchuenense*, *tenuifolium*, *tigrinum*, and *pseudo-tigrinum*. The first of these three sections may stand. The division line between the other two sections is difficult to draw, and I doubt its correctness. We have seen that Elwes judged the colour from the dried specimen to have been orange, while Franchet calls the flowers of *Davidi* "lutei," basing his opinion, if we take the written record, on Elwes' figure, *ex icone citato*. When Franchet came to describe *Fargesii* and *sutchuenense* he separated the former from *Davidi* by its glabrous perianth and by the numerous fimbriate lamellae on the perianth segments. But when he described *sutchuenense* he made no comparison with *Davidi*. I emphasise these points here because they are of moment when we come to deal with *sutchuenense* and *Thayerae*. This is all that is known in herbaria of *L. Davidi* under that name. It has not been in cultivation under that name.

In the original diagnosis of *L. sutchuenense* (Journ. de Bot., vi, 1892, 318) Franchet based his description on plants collected in two distinct areas, some collected by Prince Henri d'Orléans near Tatsien-lou, and some collected by Farges in the mountains near Tchen-keou-tin, also in the province of Szechwan. These were accepted as conspecific until comparatively recently. But for Szechwan plants coming into cultivation the question would probably not have arisen as the types are in the Paris herbarium, and duplicates in other herbaria rare. Seed was sent by the Abbé Farges to M. Maurice L. de Vilmorin. The lily flowered for the first time in 1897, and was recognised as *L. sutchuenense*, Franchet, and so named. A good account is given of it by M. Mottet in Revue Horticole, lxxi (1899), p. 475, fig. 204. Kew received it from Messrs. Vilmorin in 1897 and it flowered in July 1899. It was subsequently figured in the Bot. Mag., t. 7715. A large quantity of bulbs was sent from Szechwan by Mr. E. H. Wilson in 1904 to Messrs. Veitch. These were from Tatsien-lou where Mr. Wilson says they were common, and frequently cultivated by the peasants. That explorer found it growing in great abundance on rocky, grass-clad slopes of the Chino-Tibetan frontier at altitudes from 7000–9000 ft.

The bulbs are cooked and eaten by the Chinese. Once in cultivation this plant was also named *L. sutchuenense*, Fr. Those who had both plants in cultivation were divided in opinion. There were some who were satisfied to regard the two as the same species while others demurred.

Thus, in the "Gardeners' Chronicle," 16th August 1913, 3rd series, vol. liv, Mr. Grove writes:—

"When both lilies are cultivated under identical conditions, the typical *sutchuenense* of Franchet is seen to be a comparatively dwarf and delicate plant with slender, dark-coloured stem, now and again perhaps a yard high, but commonly a couple of feet or less. A reference to fig. 46 shows that it is but sparsely leaved—an important point—and not floriferous; in point of fact, though five or more flowers have been recorded in cases where this lily has been highly cultivated, it is usually content with three. The mature bulb is small—about the size of a peewit's egg—and the stem, which is only slightly pubescent, has a curious way of creeping about under the earth before pushing through (see fig. 45), a peculiarity it shares, so far as is known at present, only with *L. Leichtlinii*, *L. neilgherrense* and *L. philippinense*.

"The lily collected by Wilson, on the contrary, far from being a pigmy, is a fine upstanding plant from 4 to 4½ ft. high and very floriferous; in fact, in ordinary seasons and without the stimulus of any special cultivation, it will usually carry at least sixteen or seventeen blooms. These are borne on pedicels a good deal longer than those of the true *L. sutchuenense*, and, though the point is not of importance, the pedicels are a different colour. The stem is green, and as often as not is noticeably covered by minute white hairs after the fashion of *L. tigrinum Fortunei*; it is clothed as densely as *L. pomponium* with long linear leaves, and this is the most characteristic feature of the plant; the stem rises straight from the bulb, which is from 2–2¼ ins. in diameter, ivory in colour, and not at all unlike a small edition of *L. tigrinum*."

Can this have been *L. Willmottiae*?

Shortly after the issue was definitely raised by Mr. Wilson when he published a description of *L. Thayerae* in

Kew Bulletin, 1913, p. 266. There he distinguishes his species from *L. sutchuenense* by the rigid stem densely and shortly hispid, white-bearded in the leaf-axils, leaves linear-oblong, with scabrid, revolute margins, flowers in a lax pyramidal raceme and by the villose buds. Mr. Wilson splits up what he considers is Franchet's composite type, placing Prince Henri's plant under *Thayerae* and leaving Farges' plant as *sutchuenense* as the one first cultivated in Europe and figured as *sutchuenense*. It should be noted that Franchet quotes Prince Henri's plant first in his diagnosis. Franchet's description is more or less applicable to both gatherings, and in any case Franchet considered the two conspecific.

The plant or plants concerned here are not restricted in distribution to the province of Szechwan. Under the native name of Hong-pei-ho a lily is widely cultivated throughout Szechwan and all parts of Yunnan—brought also into certain of the provinces to the east of these two. The cultivation of the plant spells trouble. The difficulty arises with many Chinese plants apart from Lilium. An article of food ranging in cultivation through so wide an area would be sure to show race variations, and would certainly vary in size of bulb, rigidity of stem, and inflorescence. As regards size of bulb, vigour of growth, form of inflorescence, and especially villosity, Forrest noted in the field great divergences in what he judges to be the same plant. His specimens support his view, but on his present expedition he promises to collect more fully with a view to obtaining conclusive evidence.

Mr. Wilson tells me he has come to the decision that his *L. Thayerae* is equivalent to *L. Davidi*. This acute observation has much to commend it. We have seen that *Davidi* was based on very slight material; the foliage in the two is very similar, the slight recurving of the perianth segments is probably due to imperfections in the drying of incompletely opened flowers (I have similar stages in more than one of Forrest's Yunnan plants of this series); the colour of dried *Davidi* was orange to Mr. Elwes' eye, and, most important of all, the very remarkable villosity of the bud which persists frequently in the fully opened flowers is one of the characters employed by Mr. Wilson to mark

out his *Thayerae*. This reduction would also explain why *Davidi* has never been found again since the first gathering. Specimens have been referred either to *sutchuenense* or *Thayerae*. Franchet was so impressed by the character of the perianth segments and by the villosity that he made no comparison of *Davidi* with his new species *sutchuenense*. In requesting the loan of the type specimens of Chinese lilies from Paris I fell into the same error. I did not think it necessary to borrow the type of *Davidi* since from Elwes' illustration it seemed so completely distinct from any of the other Western Chinese lilies in its villosity. Through the kindness of Professor Lecomte I have been able to rectify this and have examined the specimen on which the plate of *L. Davidi* was based. The specimen is far from good, but the artist in Elwes' Monograph has done his best. The accompanying plate will show its present condition. There is no doubt in my mind that it is the original. It has had three flowers and many leaves. Hairs are present on some of the leaf-axils. The legend runs thus:—

"Lilium an nova species (?) insignis caule scabro, foliis linearibus margine revolutis, flore luteo (?) intus abunde maculato, extus in medio lanato (note de M. Duchartre). Recolté parmi les grandes montagnes qui separent Moupin du Setchuan, en juillet 1869 A.D."

Elwes' Monograph gives:—"Tibet orientalis, territorio 'Manze' dicto, alt. 9000 ped." The month quoted is June 1869, but as the Abbé brought only a single dried specimen of this lily, both accounts are referable to it.

The examination of the type confirms Mr. Wilson's surmise—*Davidi* and *Thayerae* are equivalent.

I must now revert to consideration of Franchet's type specimens of *sutchuenense*. Prince Henri's specimen shows no bulb; the stem is somewhat slender, densely and finely scabrid; the leaves narrow, linear, and grass-like, crowded, with tufts of whitish hairs at the base of some of the leaves; the perianth appears to have been orange with dark spots; the flower is fully expanded and shows no remains on the outer median line of any villosity. I have before me two sheets of Farges, No. 186. One shows a bulb from which the stem arises direct without any inter-

vening rhizomatous portion characteristic of the plant noted by Mr. Grove in "Gardeners' Chronicle," 16th August 1913, 3rd series, vol. liv.; the stem shows the same scabridity as Prince Henri's plant; the leaves of this plant lack the white tufts, but are otherwise similar; the flowers of which there are two fully developed with remains of other two are likewise similar; the fully expanded perianth segments show no remains of villosity. The second specimen of No. 186 has no bulb; the scabridity is very faint; the leaves similar in form and consistency show traces of the white tufts; the inflorescence is ample, showing nine fully developed flowers with remains of one or two undeveloped. They agree with the flowers of the previous specimen, and show no villosity at this stage. The differences noted between the plants of these three sheets are all practically negligible. I think Franchet's *sutchuenense*, as based on these three,[1] is distinctly one species and not two. I cannot bring the discriminating characters used in the description of *L. Thayerae* into harmony with Prince Henri's plant. The stem is if anything less rigid than in No. 186. It is equally scabridulous; No. 186 shows traces of the white beards in the axils; I can see no difference in the leaves; there is only a solitary flower. There is no trace of villosity in the flower, whatever it may have shown in the bud. The description of *L. Thayerae*, however applicable to other specimens from Szechwan and Yunnan, does not fit in with what Franchet had before him. The three sheets are conspecific, and Franchet's *sutchuenense* is a unit. I should note here that if Farges, No. 186, were left as the type of *sutchuenense* then the plant noted by Mr. Grove in "Gardeners' Chronicle," 16th August 1913, vol. liv., p. 114, fig. 45, is not equivalent. No. 186, as already noted, has a moderate-sized bulb from which the stem arises straight, while the leaves are crowded, not sparse. If the lily named *sutchuenense* in that article is a good species it is not *L. sutchuenense*, Franch. The lily with which it is contrasted is what was named later *L. Thayerae*, and now *L. Davidi*. But the characters given

[1] These three do not represent all the Paris material. I can speak only of what I have seen. Mr. Wilson tells me in a letter from Paris that he finds some of the material to be his *Willmottiae*.

in favour of the specific distinctness of this lily (in plate 45) do not impress me in view of what follows.

I bring in here some observations on the plants of this series collected in Yunnan by Forrest and others as they form an interesting corollary. Forrest collected "Pei-Ho," a plant of 2½–6 feet, with orange-scarlet flowers with crimson markings in the Lichiang Valley (No. 6391). He notes that it is cultivated by the Chinese and natives who use the bulb as an article of diet. The flowers and buds of these specimens show distinct but not copious villosity along the median line of the perianth segment. The villosity obviously tends to be easily deciduous. Mr. Wilson has noted this specimen as *L. Davidi*. On Forrest, No. 8429, collected in the Mingkwong Valley, Forrest notes the flowers as deep salmon-red, spotted deep purple-lake. He finds it on dry, open situations amongst rocks, undoubtedly wild on the hills, but cultivated by the inhabitants of the Tengyueh and adjacent valleys for the bulb which is sold as an article of food under the name of "Pei-Ho." The specimens are from 1- to 4-flowered; the bulb is on the small side; one of the buds shows a villosity comparable to the figure of *Davidi* in Elwes' Monograph. This is also named *Davidi* by Mr. Wilson.

No. 4814, collected in the Tali Valley, named *Davidi* by Mr. Wilson, has a many-flowered inflorescence; the buds and flowers are almost glabrous, but there are indications of villosity on some of the perianth segments.

No. 14,663, collected on the Mekong-Salween Divide on open rocky slopes and on cliffs, is a wild specimen; the bulb is missing, but there is an indication of a certain amount of rhizomatous growth before the development of the stem exactly comparable to the figure attached to Mr. Grove's paper referred to; the leaves are crowded, well-bearded at the axils; they, moreover, show the scabridity which is noted in the description of *Thayerae*; the buds are glabrous. I call attention to this specimen as illustrating how this wild form touches both *Thayerae* and *sutchuenense* as described.

A plant collected by Monbeig in 1907, No. 264, and probably wild, shows a rhizomatous growth, but a very scabrid stem; the leaves are crowded and somewhat

scabrid; the buds are almost glabrous. We see here again a blending of the characters of *sutchuenense* and *Thayerae*. Other collections show the same variations. Forrest, 2803, from the Lichiang Range, likewise named *Davidi*, shows slightly scabrid leaves and faint villosity on the perianth. Forrest, No. 494, from grassland on the shores of Lake Las-Hsi-pa, Yunnan, named *Davidi* by Mr. Wilson, shows the same small bulb, a distinct rhizomatous prolongation, flat, linear leaves which cannot be called scabrid, while the single flower shows no remains of villosity. It is, however, rather far developed. Here again we have the same blending of characters. From Eastern Yunnan we have Maire, 2658, which would pass for a typical *Thayerae*, except that the leaves are not scabrid, while the flowers have shed their villosity if they ever had it.

I have given these details perhaps at some wearisome length. I shall now try to summarise the foregoing:—

1. *L. Davidi*, Duchart. ex Elwes, was described from imperfect material, and too much stress laid on its very slightly revolute perianth, its villosity, and its colour. Franchet consequently did not think of contrasting it with his *sutchuenense*.

2. Mr. Wilson identifies his *Thayerae* with *Davidi*. This decision on the evidence I would accept.

3. *L. sutchuenense*, Franch., is a unit as regards the specimens cited by the author and not divisible into *sutchuenense* and *Thayerae* (i.e. *Davidi*).

4. *L. Davidi* (including *L. Thayerae*), not uncommon in the wild state, is a widely spread, cultivated lily showing many divergences in habit and in villosity. Typical *Davidi* shows pronounced villosity and little or no rhizomatous growth. But it varies to forms with glabrous perianth and creeping rhizome.

5. The form with glabrous perianth is the lily called *sutchuenense* by Franchet. This is not more than at most a variety of *Davidi*.

6. *L. Davidi* is consequently a variable lily including *Thayerae*, E. H. Wilson, and *sutchuenense*, Fr., these two forms showing a transition from marked villosity to glabrousness in the perianth.

7. As we have seen in the Yunnan specimens rhizomatous development may or may not appear. The lily in fig. 45 in "Gardeners' Chronicle" (16.8.1913), 3rd series, vol. liv., named *sutchuenense*, cannot be taken as exactly equivalent to the *sutchuenense* of Franchet, the original types of which lack rhizomatous development, but show crowded leaves and an inflorescence which is sometimes many-flowered. As I have never seen this form in cultivation, my opinion is given with reservations, but I would regard it as simply a growth form of *Davidi*, certainly more akin to the glabrous perianth state of that species (*sutchuenense*) than to the more villous state which was described as *Thayerae*.

The whole of the *Davidi* group invite comparison with the Maximowiczii and Tigrinum series from northern and eastern Asia, which appear to be parallel developments, but my acquaintance with these eastern lilies is too slight to give any value to my opinion thereon. Nor have I material to justify reference to *L. Biondii*, Baroni, *L. chinense*, Baroni, or *L. Rosthornii*, Diels.

L. Fargesii, Franch., is a member of the series, but is quite distinct from the foregoing. Franchet bracketed it with *Davidi* by colour distinctions, calling the two yellow spotted with brown as opposed to the orange-red or bright red of the other species of this group. We have seen that as regards *Davidi* this colour distinction will not hold. There is more to be said for the colour distinction as regards *Fargesii*. The plant is not in cultivation and it is difficult to be sure from dried specimens of the true colour. But to judge from several sheets which I have on loan from Paris, the colour would not appear to be a bright orange. It has a very much smaller flower than its allies, and its sparse, long, linear leaves also distinguish it. Franchet also called attention to the number of lamellae on the inner face of the segments, noting them as 4–6 in number. This seems to hold good. The lily occurs also in eastern Yunnan—*L. cupreum*, Lévl., is the same. It has the lamellar characters which Franchet observed, and on Maire's original ticket the colour is said to be "cuivré," which is additional evidence of colour distinction between this lily and *Davidi* and its forms.

There remains *L. Willmottiae*, Wilson, of which I have not seen the types. The plant comes from Hupeh. All specimens I have seen of this species are from cultivated plants. These do not agree with the original description, as the stem is certainly not weak and the leaves are 1-nerved instead of 3-nerved. I believe the plant before me, which was cultivated in the Royal Botanic Garden, Edinburgh, to be a form of *Willmottiae*. None of the characters noted in the diagnosis are individually very strong as regards specific distinction, but the sum of these characters seems to warrant the retention of *Willmottiae* as a distinct species.

IV.

L. Duchartrei, Franch., and its Allies.

The lilies concerned in this group are:—

L. Duchartrei, Franch.; *L. papilliferum*, Franch.; *L. lankongense*, Franch.; *L. Forrestii*, W. W. Sm.; *L. Farreri*, Turrill.

Franchet had the first three species in that group of Chinese Martagons which he characterised by their having papillose lamellae bordering the nectariferous furrow. He subdivided this group by colour distinctions and the three species noted were placed together as having flowers either white, spotted with brown, or flowers of a winey-red tint.

L. Forrestii, W. W. Sm., appears in Notes of the Royal Botanic Garden, vol. viii, p. 192 (1914), and was described as akin to *L. Fargesii*, Franch. *L. Farreri*, Turrill, appeared in "Gard. Chron.," 3rd series, vol. lxvi, p. 76 (9.8.19), and was described as akin to *L. Duchartrei*, Franch.

I have examined in detail the type sheets from Paris of *L. lankongense*, Franch. (Delavay, n. 4437) from Lankong, Yunnan. Franchet in his description lays stress on the fact that the stem is covered with leaves to the base, which character he states is very rare among the lilies of this group. This is a very slender character on which to base specific distinction and would require to be supported by other characters. I understand from Mr. Forrest that the Lankong area, which he has himself visited, is a very arid region, consisting geologically of limestones and sand-

stones principally. *L. lankongense* is in the type sheet very much dwarfed. The characters of the bulb and rhizome, of the leaves, and of the details of the flower correspond very closely with *L. Duchartrei*. The presence of leaves towards the base of the stem seems to me to be conditioned by the absence or sparse production of other plants or herbage in the vicinity. Mr. Forrest, Mr. Wilson, and I have examined the type together and agree that it represents nothing more than a dwarfish state of *L. Duchartrei*, Franch.

When I named *L. Forrestii* I had, as I thought, no adequate material of *L. Duchartrei* available and I laid undue stress on the yellowish-rose ground-colour. Mr. Wilson, who examined the types, gave it as his opinion that it is also a form of *Duchartrei*. The leaves are shorter and broader than what obtains in typical *Duchartrei*, but Mr. Wilson is right, and I accept the reduction. It is only a form of that species at most and not worthy of even a varietal name.

L. Farreri, Turrill, was collected by Mr. Farrer in Kansu in 1914 under No. 183. No dried specimens of it were sent home by Mr. Farrer. The plants were grown in this country in several places from seeds forwarded by Mr. Farrer. When Mr. Farrer first found it he was remote from books and thought that he had possibly stumbled on the *L. Davidi* of Elwes' Monograph. I quote from "Gard. Chron.," 3rd series, vol. lvii, p. 1 (2.1.15), what he says of it:—

"All the banks are aflame with the scarlet of *Lilium tenuifolium* amid mounded lavender masses of a very delightful *Aster* of *acris* relationship, which always forms into a neat round dome, and flowers simultaneously in such profusion that you can see its crowded blobs of lilac from far away on the green hills, amid the fiery haze of the lilies. There is another lily, too, but this is rarer, and begins only at higher elevations, in a more limited district. It haunts cool mountain slopes and river banks amid the coppice. I cannot perfectly recall the figure of *L. Davidi* (which I incline to believe this lily to be), or I could be more certain as to what is, or is not, the name of this. *L. Davidi* on its recent introduction was hailed as a

disappointment by comparison with the seductive plate in Elwes' Monograph; but this dainty lily could surely not be despised by anyone. With broader, clear-green leaves, it is a match in habit for *L. tenuifolium*, as that species grows here, noble and dainty, far ampler and more splendid than it is often seen in England. It attains some 15 inches in height, and carries one, two, or three pendant Martagon flowers of a cold ivory or paper-white, waxy in texture, and freckled rather unnecessarily with maroon along the inner margins of their segments. The flowers are larger and fatter than those of *L. tenuifolium*, and I find it an attractive beauty, as it hangs glacial and pure amid the scrub. Its site, soil, and habit suggest little difficulty in its culture. But it can never have the brilliancy of *L. tenuifolium* as the Thibetans grow it; for they ram a handful of bulbs at haphazard into the hard mud of their flat roofs, and there above the eave sprouts a living pyramid of fire from year to year."

The bulbs received by the Royal Botanic Garden, Edinburgh, grew well and produced a lily which was figured, and the figure was sent to Mr. Grove for his opinion. Mr. Grove identified it as *L. Duchartrei*, Franch. It had a white ground-colour suffused with rose, and the white hair tufts in the axils of the leaves were more or less absent. With its identification as *L. Duchartrei* I am quite in accord. Plants believed to be of the same gathering were cultivated by Mr. F. C. Stern, at Goring-by-sea, Sussex. I have a figure made from a fresh specimen of this lily. It corresponds closely to Mr. Farrer's description of a cold ivory-white, and the leaf axils are conspicuously white-bearded. The flowers seem to be somewhat smaller than usual in typical *L. Duchartrei*. Unless Mr. Farrer erred in the field, we have only one lily to deal with. The colour differences are at most only varietal. The tufts of hairs in the axils occur in several series and are not constant. In any case the Paris type of *L. Duchartrei* shows these hairs. The small size of the flower in *L. Farreri* would appear to be due to cultural conditions. I cannot see more in *L. Farreri* than a form of *L. Duchartrei* at most. In this conclusion Mr. Grove and Mr. Wilson concur.

We are now left with only two distinct species of the series, *L. Duchartrei* itself and *L. papilliferum*.

L. Duchartrei is recorded from Moupine in Szechwan (coll. David); from Tatsien-lou (coll. Prince Henri d'Orleans); from Kansu (coll. Farrer); among the Yunnan records are Mo-so-yn (coll. Delavay, n. 3983); Lankong (Delavay, n. 4437); Hee-chan-men (Delavay, n. 2559). These two records appear under *lankongense* in Franchet's description as does also Mo-so-yn in the woods of Koutoui (Delavay, n. 3797), which is the exact locality given by Franchet for one of the records of *L. Duchartrei*. Further Yunnan records are Chungtien plateau (Forrest, No. 496), previously reported in Notes Roy. Bot. Gard., vol. vii, p. 38 (1912), as *L. papilliferum*, Franchet; Lichiang Range (Forrest, No. 2692), also previously recorded as *papilliferum*, op. cit., p. 154; Lichiang Range (Forrest, Nos. 6224 and 6582) under *Forrestii*; mountains in the north-east of Yangtze bend (Forrest, No. 10,637); Mekong-Salween Divide (Forrest, No. 14,238); Doker-la, Mekong-Salween Divide (Forrest, No. 16,730); north-west Yunnan, near Tsekou (Monbeig, 263).

The species consequently extends throughout the alpine areas in the west of the provinces of Kansu, Szechwan, and Yunnan. Under *L. polyphyllum* in Elwes' Monograph there is a suggestion that that species extends east to the frontiers of China and Tibet. The plant Mr. Elwes had in view was no doubt *L. Duchartrei*, at the time unnamed. Apart from bulb characters *L. polyphyllum* is readily distinguished by the glabrous sulcus.

Franchet distinguishes his *L. papilliferum* from *Duchartrei* by the narrow leaves, by the papillose villosity of the stem, and by the colour of the flowers. These are all in this instance satisfactory characters. Forrest collected the species in the mountains west of Feng-kou (No. 12,984); on the Kari Pass, Mekong-Yangtze Divide (No. 13,006); on the Mekong-Salween Divide in Lat. 28° 10′ N. (No. 13,412). These specimens are quite in accord with Franchet's types. Forrest gives the colour as deep crimson, or dull crimson, or deep crimson-maroon. Mr. Forrest notes further that it is cultivated by the Chinese. His own specimens were obtained from ledges of cliffs or

on stony pasture. In the development of its bulb it is very similar to *L. Duchartrei.*

V.

L. Bakerianum, Coll. et Hemsl., and its Allies.

We have in this group a good illustration of the overlapping in nomenclature which has resulted from the more or less contemporaneous description some thirty years ago of Yunnan species at Paris and Burmese species at Kew. Geographically the two areas are continuous and the flora has much in common, especially in genera where there tends to be a wide distribution of individual species as is the case in *Lilium.* The Burmese representatives are *L. Bakerianum* and *L. Lowii.* The species described by Franchet which pertain to this group are *L. Delavayi* and *L. yunnanense.* Franchet in his key, Journ. de Bot., xii (1898), 308, associated with these two the following:— *L. formosum, L. myriophyllum,* and *L. concolor.*

The last mentioned has little in common with the group and may be at once left out. Although placed by Franchet among the lilies with perianth "regulièrement évasé de la base au sommet," *formosum* and *myriophyllum* have their affinity in the *longiflorum-Wallichianum* series and need never be confused with the *Bakerianum* group. *L. Henrici,* Franchet, Journ. de Bot., xii (1898), 220, is stated by its author to be near *Delavayi*:—

"Le *L. Henrici* peut-être placé au voisinage du *L. Delavayi,* dont il diffère bien nettement par la coloration de ses fleurs, ses longs pédoncules et ses feuilles allongées, très rapprochées sur la tige."

Allowing that *Henrici* is correctly referred to *Lilium,* it has no close connection with the *Bakerianum* series, but in point of fact as regards habit and structure of the flower it comes very near to *Nomocharis* of which genus it may be a member. There is also *L. linceorum,* Lévl., which as I have shown is only *Delavayi* (*supra,* p. 139). Finally there is *L. sempervivoideum,* Lévl., which has claims to specific distinctness. There are consequently five lilies for comparison within the *Bakerianum* group:—

L. Bakerianum, *L. Lowii*, *L. Delavayi*, *L. yunnanense*, *L. sempervivoideum*.

The history of the description of the first four shows an interesting parallel. *L. Bakerianum*, Coll. et Hemsl., was first published in Journ. Linn. Soc., xxviii (1890), 138, pl. xxii. It is described as having white flowers and remarkable for the short genitalia. No particular affinity is given unless in the note that it is "intermediate in character between *L. davuricum*, Gawl., and *L. japonicum*, Thunb."—a comparison which it is difficult for me to appreciate. In May 1892, in Bot. Mag., t. 7232, appeared *L. Lowii*, Baker. It was contrasted with *nepalense* and *Bakerianum*. The latter is said to differ in the erect flowers, shorter stamens, and inner segments of the perianth much broader than the outer. The perianth showed "reddish-purple" or "claret-brown" spotting on the lower inside half of segments. When these Burmese lilies were in cultivation (along with *sulphureum* and the Burmese form of *nepalense*) they attracted attention, among other points, by their variability, especially in colour. Thus amid several references in horticultural literature I quote from Mallett in "The Garden," vol. lxiv (1903), p. 333:—

"*Lilium Bakerianum* (Collett and Hemsley), syn. *L. Lowii* (Baker), Professor Baker's Lily. A recent and valuable addition to our garden lilies, though known long ago. Very distinct in the shape and colouring of its flowers. Bulbs 4 ins. in circumference, white, purplish when exposed, globose, very fibrous, roots stout and of several years' duration. Stems very slender, smooth or slightly rough, 3 ft. long, bearing one to three bulbils and a few roots at their bases. Leaves mere bracts below, largest (3 ins. long) at the middle of the stem, dark glossy green, rough beneath, lance-shaped, scattered, ascending. Flowers two to five in a loose umbel, horizontally poised or drooping, trumpet shaped, 3 ins. across, 4 ins. long, white, spotted brown low down the distended funnel, coloured greenish externally, especially on the midribs; the petal tips slightly recurve, and the anthers are yellow; very variable. Flowers in July. The Burmese forms are mainly smooth-leaved, and the Yunnan forms rough on the under

side. We have seen specimens heavily spotted with claret nearly up to the petal tips, and others scarcely at all spotted and with a faint lilac flush at the throat. A few only are fragrant. Inhabits varied sites on high mountain ranges 4000 ft. to 6000 ft. above sea-level. Upper Burma and Yunnan. Its suppressed leaves at the base of the stems indicate association with scrub."

Doubts arose as to the specific distinctness of *Lowii* from *Bakerianum*. The general trend was to regard it as a variety at most. Yunnan plants were mentioned as the same but without reference to any distinct species of Franchet. The latter's diagnoses of *Delavayi* and of *yunnanense* appeared in September 1892 (Journ. de Bot., vi, p. 314). *Yunnanense* appears first and is compared with *japonicum*, Thunb., as regards the flower. *Delavayi* on the same page has its flowers contrasted with *candidum*. Even in the key, *op. cit.* 308, the two species are not so placed as to suggest comparison except as regards colour distinctions. *Yunnanense* is placed among the species with flowers white or tinted violet on the exterior. *Delavayi* among "rouge cocciné ou lie du vin presque toujours maculées de brun ou de noir." It must be said for Franchet that in the type specimens there is no immediate suggestion of proximity, but the access of ampler material of these lilies has brought forms which bridge the gap between the two. *Yunnanense* occupies the place of *Bakerianum*, while *Delavayi* has a very close connection with *Lowii*. We have consequently in Burma the white *Bakerianum* giving at the extreme the deep spotted or tesselated *Lowii* and in Yunnan the white *yunnanense* extending to the olive dark-spotted *Delavayi*.

Forrest has collected *yunnanense* in Yunnan several times:—

Mountains in the north-east of the Yangtze bend, flowers pure white, minutely speckled maroon on basal half interior, fragrant, No. 10,545; Kari Pass, Mekong-Yangtze Divide, flowers white, faintly tinged rose on exterior, No. 12,977. (This is a remarkable gathering in its variations; the largest plants are 2 ft. high with white flowers 3 ins. long; there are also plants of 1 ft. high with rose-tinted, speckled

flowers 1½ in. long and leaves densely scabridulous below; also half-developed plants of 6 ins., with crowded leaves yet with flowers almost fully open. Forrest made sure on the spot that these were all conspecific. A study of the specimens under this number shows conclusively how easily specific names could be attached to forms of this lily—and with apparent good reason, had not the series been carefully examined in the field); also in mountains east of Yung-ning, flower white, fragrant, No. 16,934. All these sheets I had named as *yunnanense* and they conform to Franchet's type. Mr. Wilson has marked them *Bakerianum*, implying that he considers Franchet's species equivalent to *Bakerianum* which was described two years earlier. On the evidence both botanical and geographical this reduction I accept. Henry's No. 13,026 from Szemao, flowers white, is the same; it was identified as such by Wright in Journ. Linn. Soc., xxxvi (1903), p. 128. Henry, No. 10,774, from Mentze, pinkish flowers, is also the same.

Conspecific with Franchet's types of *Delavayi* are Forrest, No. 10,317, from the Lichiang Range, very heavily spotted to the tips of the perianth segments; No. 8499 from lava bed west of Tengyueh, flowers dull olive-green, spotted reddish-purple; No. 1893 from the Tali Range, pale greenish-yellow, spotted on interior crimson; No. 2433 from the Lichiang Range, olive-brown, spotted deep purple; No. 5824 from the Lichiang Range, olive-brown, spotted crimson; No. 7137 from Tali Range with eight flowers, deep brownish-olive, spotted maroon. Maire, Nos. 2221, 2654, from Yunnan-sen and Léveillé's type of *linceorum* are also referable here. There is much variation in the spotting, some having so little as to approach *Bakerianum* and certainly to touch *Lowii*. The style varies much in length, sometimes twice the ovary as in Franchet's description, sometimes more or less equal to it. This is not by any means due to changes in the process of anthesis.

Are all these lilies to be regarded as simply modifications of one variable species? Mr. Wilson has referred all the Yunnan *Delavayi* to *L. Bakerianum*, Coll. et Hemsl. var. *Delavayi*, Wils. *L. Lowii* is probably nothing but a spotted form of *Bakerianum*, but the ground-colour is still white with a suggestion of green on the outside.

Franchet's types (rubro-vinosi) and Forrest's specimens (olive, olive-brown, dull olive-green) are consistent in their avoidance of white, while *yunnanense* is always in Forrest's experience pure white (tinged sometimes with rose). Mr. Forrest was at one time of the opinion that *Delavayi* showed no refraction of the segment tips, but in photographs afterwards obtained by him *in situ* there is a recurving similar to what is found in *Bakerianum*. His experience in the field of what have been termed *yunnanense* and *Delavayi* led him to the conclusion that the two are distinct from one another. Accordingly my inclination is to keep *Delavayi* as a species closely allied though it may be to *L. Bakerianum*; to regard *yunnanense* as equivalent to *L. Bakerianum*; to consider *Lowii* as a spotted variety of *Bakerianum* on the way towards *Delavayi*. I am, however, not at all sure but that *Lowii* represents most forms of *Delavayi*, and as *Lowii* was described first that name would have precedence. But the name *Delavayi* represents the olive lily of Yunnan with dark spots, and while the doubt remains, that name is on the whole more worthy of retention. There is still *L. sempervivoideum*, Lévl. The original description in Bull. de Geog. Bot., xxv. (1915), 38, is appended.

"Insignissimum bulbo plurisquamatum; squamis omnino liberis lanceolatis confertissime rosulatis, erecto-patentibus, folia graminea conferta 1–2 mm. lata curta; flos unicus raro geminus albus, nutans, intus rufo vel rubro punctatus.

"Yun-Nan: collines rocailleuses ou herbeuses de ou en face de Siao Ou-Long, juin-juill. 1911 et 1912 (E. E. Maire)."

There is ample material of this in Herb. Lévl. Henry, No. 10,743, from Mengtze, with pink flowers may be considered along with it; it was named *yunnanense* in Journ. Linn. Soc., xxxvi. (1903), 136. It differs from Franchet's description and types in (1) the stem being smooth and not scabrid, (2) leaves scarcely tri-nerved and not scabrid on the veins, (3) flowers pink and only 4–5 cm. long, (4) the style is twice the ovary. To this in Herb. Kew., Mr. Wilson has affixed the name of *L. amoenum*, Wils., but after seeing Léveillé's type of *sempervivoideum* decided it was equivalent. There is also in Herb. Edin. two gather-

ings of Maire from the vicinity of Yunnan-sen, Nos. 1302, 2238, with no legend save "Lys rouge—hautes cimes." This is the same plant.

The type needs ampler description:—

The bulb and rhizome is that of *L. yunnanense* (*Bakerianum*). Stem slender, about 30 cm. high, glabrous, but *sometimes* finely scabridulous; leaves linear, crowded, 4–5·5 cm. long, about 2 mm. broad, 1-nerved, sometimes faintly 3-nerved, glabrous, or at times with a fine scabridulous early deciduous indumentum—reminiscent of that of *yunnanense* but much finer. Flower 1–3, usually solitary; 3–4 cm. long; perianth similar otherwise to *yunnanense*; style 2 times the ovary. In Maire's Yunnan-sen specimens the colour of the flowers is much deeper and the style equals three times the ovary. In Henry, 10,743, the leaves are a little larger, up to 6 cm. but much broader (up to 6 mm.), and are much less crowded. But it is the same lily. Its close affinity to *yunnanense* (*Bakerianum*) is undoubted. It is what *yunnanense* might be expected to be in the comparatively dry, sub-arid East Yunnan. Only Henry, No. 10,774, shows that *Bakerianum* more or less typical is also at Mengtze. The sum of the differences between *sempervivoideum* and *Bakerianum* are, however, sufficient for specific distinction. I quote Maire's three original tickets as Léveillé gave an abbreviated statement of these.

"Lilium bulbeux: (rare) fl. blanches, pointilles de rouge à l'intérieur; rochers en face de Siao-ou-long. Alt. 2550 m."

"Lilium bulbeux; fl. blanches-penchées; collines herbeuses de Siao-ou-long. Alt. 2550 m."

"Lilium bulbeux; fl. blanches, penchées, pointillées de roux en dedans; collines rocailleuses de Siao-ou-long. Alt. 2600 m."

The colour of the flower varies from white to a deep pink.

Lilium Stewartianum, Balf. f. et W. W. Sm.

W. W. Smith.

Lilium Tenii, Lévl.

W. W. Smith.

PLANTES DE CHINE (YUNNAN)

Lilium Tenii, Lévl.

W. W. Smith.

Lilium Davidi, Duch.

W. W. Smith.

TRANSACTIONS AND PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

VOLUME XXVIII.

PART IV.

SESSION 1922–23.

EDINBURGH:
PRINTED FOR THE BOTANICAL SOCIETY BY
NEILL & CO., LIMITED.

And to be obtained from the SECRETARY OF THE SOCIETY, *at the Royal Botanic Garden.*

1923.

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TRANSACTIONS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXVII

The Seedling Structure of Salix pentandra, Linn.

By Ian W. Seaton, B.Sc. (With Pl. VIII.)

(Read 16th November 1922.)

So far as I can ascertain, no record has been made, hitherto, of the germination of the seed of *Salix pentandra*. The seeds are minute and are adapted for wind dispersal by the possession of a parachute of long silky hairs. This parachute is an arillar structure and the hairs arise in groups of three or four from a ring formed of their contiguous bases. This ring fits on to the lower or radicle end of the seed (fig. 1). On moistening, it expands slightly and is then completely and easily detachable. The seed is pear-shaped and has a thin brown testa which conforms in shape to the enclosed embryo (fig. 2).

The embryo has oblong-oval, plano-convex cotyledons, the plane, adaxial faces of which are closely adpressed, a short, stout hypocotyl which ends abruptly, and a very small, terminal, peg-like radicle (fig. 3). The whole embryo, with the exception of the radicle, is green and shining.

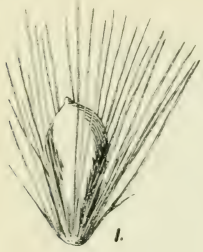
The seed is exalbuminous, the food reserve being stored in the cotyledons, which are comparatively large and fleshy. The embryo is nearly straight in this resting condition. The first process of germination is the elongation of the hypocotyl. Growth is more rapid along one side, and the seedling becomes bent in consequence. This arching, convex towards the soil surface, splits the seed coat and the curved middle part of the

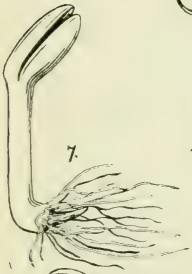
hypocotyl protrudes, eventually coming above the soil level (figs. 4, 5, and 6). It is then seen that the bending is such that one cotyledon is directly above the other as they are withdrawn from the testa (fig. 7). Germination, then, is epigeal.

A straightening of the hypocotyl next ensues, and, as this process is nearing completion, the cotyledons begin to expand (figs. 8 and 9). Meantime, from the blunt lower end of the hypocotyl, which becomes tinged with red, there grow out numerous unicellular hairs, which act as would root hairs in the double function of fixation and absorption, though the former is probably their primary function in the natural habitat of the plant. This production of hairs from the hypocotyl conforms with the behaviour during germination of the macropodous embryos of typical helobic plants, and is, no doubt, correlated with the slow development of the radicle and the more immediate need of fixation. The radicle begins to show growth only after a perfect mat of these hairs has been produced round and above its area of attachment to the hypocotyl. Its further development, once initiated, seems to be fairly rapid, and later it bears a few root hairs in the usual definite area (fig. 10). The expanded cotyledons are only slightly larger than they are in the seed, and each now shows a very short petiole slightly thickened at its insertion on the hypocotyl. There is a very indistinct midrib in the cotyledon and a rather more noticeable apical indentation.

Although germination is quick, the seed coat being split on the fourth or fifth day, the plumule is slow in evolving, and is just discernible in seedlings about five weeks old (fig. 10). Following this stage growth is very slow, and after seven months the seedling has just produced its seventh leaf.

The first leaf produced is small, obovate, retuse and entire, with a distinct midrib but no other discernible venation. The second leaf differs, apart from its greater size, in having no apical indentation. The third tapers towards the base, is elliptical or oval, acute and entire, or may have one or two small teeth on each side. The ultimate leaves are variable, usually elliptical, acute, sometimes very shortly cuspidate, and are increasingly serrulate. All the leaves are a fresh shining green colour above, glaucous beneath, glabrous, simple, alternate, and petiolate. From the third leaf onwards they are alternately incurvinerved (fig. 11).





I. W. Seaton.

There is one point of more than ordinary interest about the germination of Salix as described in the foregoing paragraphs. Mr L. B. Stewart, Royal Botanic Garden, Edinburgh, has tried to germinate willow seed of most of the British species, during the last twenty years, and until now has had to confess failure. It was he who first drew my attention to the seedlings, and to him I am indebted for specimens. The seed used on this occasion was gathered by Dr. M. Wilson early in October from a tree near Bavelaw, on the edge of Balerno Moor. A second sample gathered from the same tree a fortnight later germinated just as successfully as the first supply. Both samples were collected in perfect condition, just as the seed was escaping from the capsules. Since the seeds are minute and since the embryos are green, it seems not improbable that immediate sowing is necessary to ensure germination. The seed did not receive any special treatment. It was grown in a pit at 60°–65° F. and germinated fairly freely in sand, in soil, and on moist filter paper. Another visit to the tree about 18th November resulted in the discovery of some seedlings germinated under natural conditions. These had just attained the expanded cotyledon stage shown in fig. 10.

There is a record by Sir John Lubbock (On Seedlings, vol. ii, p. 542) of the germination of two species of Willow, *S. cinerea* and *S. repens*, a seedling of the latter being figured. Comparison of the measurements of *S. repens* seed with those given in his account indicates that the cotyledons grow to a considerable extent in that species. No such growth could be determined in the case of *S. pentandra*.

EXPLANATION OF PLATE VIII.

Figs. 1–10 are ten times natural size; fig. 11 twice natural size.
Fig. 1. Seed of *Salix pentandra* with aril.
Fig. 2. Seed with aril removed.
Fig. 3. Embryo removed from seed coat.
Figs. 4–11. Stages in germination.
Fig. 4. Seedling five days after germination.
Fig. 10. Seedling five weeks old.
Fig. 11. Seedling seven months old.

PUCCINIA MIRABILISSIMA, PECK, A NEW BRITISH RECORD.

By MALCOLM WILSON, D.Sc., F.R.S.E., Reader in Mycology, University of Edinburgh.

(Read 16th November 1922.)

The occurrence in the vicinity of Edinburgh of *Puccinia mirabilissima*, a species hitherto only recorded from the Unites States of America, is a somewhat surprising circumstance. Up to the present this rust has been found in Utah, Montana, Colorado, and in the Sierra Nevada Mountains,[1] and there is a single record from Washington.[2] The fungus usually occurs on *Berberis repens*, but has also been found on *B. pinnata*, *B. nana*, *B. pumila*, and *B. Aquifolia*, species which are all included in the sub-genus *Mahonia*. It was first collected at Colinton near Edinburgh in October 1922 on *B. Aquifolia*, and has later been found on the same host at Newlands, Peeblesshire.

The fungus produces its small reddish sori abundantly on the under surface of the leaf, the attacked plants being rendered very conspicuous by the development of bright red spots on the upper leaf surface opposite to the fructifications. Up to the present only uredospores and teleutospores have been found, and these occur in the same sori. It is still doubtful whether any other spore stage is produced by the fungus, for though aecidia have been described on *B. repens* in the United States, the specific connection between these and the uredospores and teleutospores has not been proved.

The cushion-shaped almost hemispherical sori are made up of a large number of uredospores, intermingled with which are a few teleutospores. The uredospores possess long colourless pedicels which radiate out from the centre and form the bulk of the compact sorus. The uredospores are attached to these by a distinct articulation, and only separate at maturity, leaving the pedicels still in the sorus (fig. 1, p. 166). The spores are obovate or pyriform, with finely rugose wall, averaging $30 \times 18\,\mu$. Each possesses 2–4, usually 3, equatorially arranged

[1] Blasdale, W. C.: Observations on *Puccinia mirabilissima*. Erythea, vol. iii, 1895, p. 131.

[2] Plant Disease Survey, Supp. 23, 1922. Bur. Plant Industry, Dept. Agric. U.S.A.

germ-pores (figs. 2 and 3). The walls are unusually thick, and in consequence the spores bear some resemblance to unicellular teleutospores; in consequence, the species was originally incorrectly placed in the genus *Uromyces* as *U. sanguineus*.

The teleutospores possess unusually long pedicels, and in consequence project beyond the uredospores in the sorus. The pedicel is hyaline up to 200 μ long, and throughout almost the whole of its length the walls are so thick that the cell cavity is occluded. At the base, where the pedicel is often swollen, the walls are much thinner and the cell cavity is obvious (fig. 6). The wall consists of four layers. The innermost, next to the contents, is thin and dark coloured, and immediately outside this is the thick brown warted layer. This is followed by a hyaline layer, seen particularly at the apex and sides, and on the surface there is a very fine cuticularised layer. Two germ-pores are present in each cell, situated usually about the middle of the lateral walls; all the germ-pores usually lie in the same plane (figs. 5 and 8). The teleutospores average 35×24 μ.

In many cases the pedicel is not attached exactly at the base of the spore (figs. 6 and 10), and in a few cases the attachment is at the side of one cell, so that the longitudinal axis of the spore is at right angles to the pedicel (fig. 7). The peculiar three- and four-celled teleutospores described by Blasdale [1] were not observed.

Germination takes place within twenty-four hours when the spores are placed in water. The uredospore usually produces two germ-tubes, which generally soon give rise to two or three branches (fig. 4). The teleutospore, on germination, produces one germ-tube from each cell, and these may be either on the same or on opposite sides of the spore (figs. 9 and 10). Sporidia were not produced in the hanging drops.

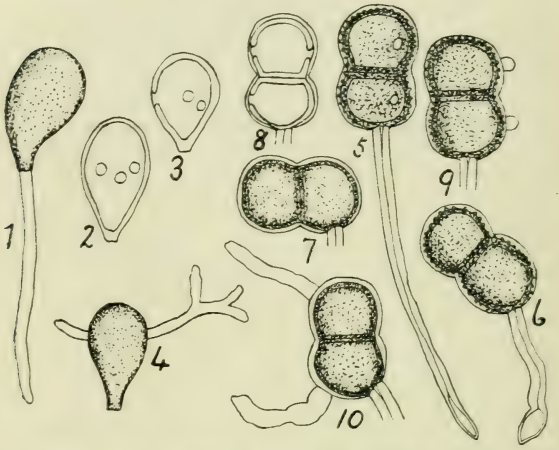
On account of the structure of the wall of the teleutospore and the presence of two germ-pores in each cell, this rust was removed from *Puccinia* by Magnus [2] and placed in the genus *Uropyxis*, Schröt. Sydow,[3] however, considers that *Uropyxis*

[1] *Loc. cit.*

[2] Über die Gattung *Uropyxis*, Ber. d. deutsch. bot. Ges., xvii, 1899, p. 119.

[3] Monographia Uredinearum, vol. i, p. 844.

is not of generic rank, and makes it a section of the genus *Puccinia*. The forms placed in this section are nearly all American, and none of the British species hitherto recorded are included in it.



1. Uredospore with pedicel. 2 and 3. Uredospores in optical section showing germ-pores. 4. Germinating uredospore. 5. Teleutospore showing germ-pores in surface view. 6 and 7. Teleutospores showing variation in point of attachment of pedicel. 8. Teleutospore in optical section showing germ-pores; one pore in the lower cell is at a slightly lower level. 9 and 10. Germinating teleutospores.

The method of dehiscence of the spores in this rust is of interest. As already described, the uredospores are distinctly articulated to their pedicels and become easily detached from them. The sorus has a powdery appearance, due to the large number of detached uredospores lying on its surface, the pedicels of which make up the inner portion of the compact fructification. The few teleutospores in each sorus project beyond the uredospore layer on account of their long pedicels. Dietel [1] has pointed out that in this and several other rusts the base of the teleutospore pedicel rapidly absorbs water when placed in it, and, in consequence, swells and

[1] Über Quellungserscheinungen an den Teleutosporenstielen von Uredineen, Jahrb. wiss. Bot., xxvi, 1894, p. 49.

becomes wedge-shaped, as seen in fig. 6. In the case of *P. mirabilissima*, the teleutospore pedicel is packed in tightly between the uredospore pedicels, and the swelling of the base of the former produces pressure in the sorus which causes the teleutospore, together with its persistent pedicel, to be violently shot out. This process can be readily observed under the microscope when sori removed from leaves which have been kept for a short time in dry air are mounted in water.

The introduction of *P. mirabilissima* into Scotland probably took place comparatively recently, for it is hardly conceivable that this conspicuous rust can have existed for a long period in the neighbourhood of Edinburgh without being observed. *Berberis Aquifolia* was introduced into this country from America in 1823, and is now extensively grown in gardens and shrubberies. It is easily reproduced and it is improbable that living plants have been brought in from that continent in recent years. From the known facts, it seems unlikely that the rust was introduced on this host. It may have been introduced on some other species of *Berberis* and subsequently spread to *B. Aquifolia*, but again there is no evidence for this. The introduction of living spores on the surface of plants not belonging to any of the host species is also a possibility. Shrubs and trees, especially conifers, are brought into the country in fairly large numbers, and there is no doubt that numerous living fungal spores are introduced on these. The occurrence of the rust in two situations which are over 20 miles apart suggests that its spread may now take place rapidly, and the common occurrence of the host plant will undoubtedly facilitate its distribution.

Observations on the Leaf of Senecio gonocladus, Sch. Bip. By Dorothy G. Wilson, M.A., B.Sc.

(Read 21st December 1922.)

A native of the Cape region of South Africa, *Senecio gonocladus* is a distinct xerophyte, characterised especially by the succulence of its cylindrical leaves, which measure about one inch in length and are covered externally by a coating of wax.

The leaf of this plant exhibits a peculiar and unusual structural feature. On the adaxial side, from the base of the leaf to the tip, there runs a strip of tissue which, compared with the rest of the leaf, is almost translucent. This area we have named the " window " of the leaf. In transverse section this translucent tissue is found to occupy about four-fifths of the total area, and microscopic inspection shows that it is structurally different from the remaining portion, or what may be called normal tissue of the leaf.

In the normal tissue, a layer of wax is present on the external surface, covering the epidermis, which consists of two rows of cells. These are arranged regularly, are rectangular in shape and thick-walled, the external walls of the cells of the outer row being especially thick. The inner row of cells of this double epidermis is interrupted at intervals by oil-ducts. Within the line of ducts, the normal tissue of the leaf is composed of parenchymatous, chlorophyll-containing cells, of fairly uniform size and shape. Vascular bundles, varying in number in different leaves, are embedded in the general parenchyma of the leaf and are arranged somewhat irregularly. Stomata are few in number, and where present are found in pits.

In the translucent tissue of the leaf a coating of wax is also present, covering as before a two-layered epidermis. But no oil-ducts are present and stomata are absent. The deeper-lying tissue is parenchymatous, the cells larger than in the normal tissue, with thinner walls and without chloroplasts. Nor are vascular strands present in this translucent tissue.

It thus becomes an interesting question as to whether the " window " is of any particular use to the plant. The translucency suggests that it may allow light to penetrate more readily to the chlorophyll-bearing tissues, thus facilitating photosynthesis. As the cell-walls are thin, light will penetrate them more easily, and as the cells are larger than those of the normal tissue, there are fewer walls to pass through.

Since the photosynthetic process results in an increase in weight, if it can be shown that the increase in a control leaf is greater than the increase in a leaf with the " window " blocked, both exposed to the same intensity of light for the same length of time, there would be reason to believe that the

" window " does have some effect on the total amount of light reaching the deeper tissues.

In this connection, the conclusions given below were based on the method employed by Sachs. This experimenter removed, in the morning, portions of leaves of equal area, or actual halves, dried these and then weighed. The remaining portions or halves were exposed all day and in the evening similarly dried and weighed. Increase in weight indicated gain due to photosynthesis.

In the cylindrical leaves of *S. gonocladus*, surface areas cannot readily be compared, but it was found that if leaves of equal thickness are carefully selected, cylinders can be punched out of them the weights of which are approximately the same, the probable error of the mean weight of the samples taken being less than 1 per cent.

Plants of *S. gonocladus* were thus selected with leaves of similar size. Some of the leaves were left in their normal condition and in an equal number the " windows " were blocked by painting them with indian ink. The plants were then placed in the dark until the leaves were found to be starch free. Cylinders were then punched out of half the normal leaves selected and from half of those with the " windows " blocked. These were weighed, and dried at 100° C. until the dry weight remained constant. The remaining leaves were exposed to light for varying lengths of time, after which drying and weighing was carried out as before.

In all the experiments performed, whether sunlight or artificial light was employed, it was found that the gain in dry weight in the leaf with the " window " blocked was less than the gain in the normal leaf. The experiments suggest, in fact, that the translucent tissue in the leaf is used by the plant as a means of illumination.

In conclusion, I have to express my thanks to Professor Wright Smith, Royal Botanic Garden, Edinburgh, for his kindness in providing facilities for the experiments carried out, and also to Dr. Graham and to Mr. L. B. Stewart for drawing my attention to the peculiarity in the structure of the leaf and for suggesting an experimental inquiry into its significance.

Notes on Scottish Plants. By J. R. Matthews, M.A., F.L.S.

(Read 15th February 1923.)

Ten years have elapsed since the publication of Notes on Mid-Perth Plants (Journ. Bot., 1913, p. 193), and although but a limited amount of field-work in that area has been accomplished during the interval, several plants of sufficient interest to justify some record of them have come under observation. While the notes which follow deal mainly with material collected in Mid-Perth, vice-county 88, mostly from the Lowland Earn district, reference is made also to certain plants gathered in other parts of Scotland. In these cases the Watsonian number or name of the county is indicated; where no such details are given the record refers to Mid-Perth.

I have had the valued and experienced aid of Mr. Arthur Bennett in dealing with certain difficult genera, especially *Potamogeton*, and Dr. Eric Drabble has kindly confirmed the naming of the pansies; to both gentlemen I am much indebted for their assistance.

Corydalis claviculata, DC. This is rare and local, especially in the Lowland districts of Perthshire. It occurs on wet, rocky places, Craig Rossie, Ochils—a somewhat isolated station.

Draba incana, L. var. *confusa* (Ehrh.). Ben Ledi. Quite characteristic, fruits with stellate hairs.

Sisymbrium altissimum, L. Railway bank, Dunning. An alien which is spreading.

Erysimum cheiranthoides, L. Apparently established on waste ground, near Tobermory, v.-c. 103, Mid-Ebudes. Dunn, in Alien Flora of Britain, remarks that it becomes rapidly rarer and less permanent northwards. Its occurrence in Mull would seem to indicate a widening range in the distribution of the plant. It is queried for v.-c. 103 by Ewing in The Glasgow Catalogue of Native and Established Plants.

Viola agrestis, Jord. One of the commonest segregates of *V. arvensis*, Murr. 72 Dumfries, 73 Kirkcudbright, 85 Kinross, 88 Mid-Perth.—*V. segetalis*, Jord. Cultivated land west of Dunning, and near Milnathort, v.-c. 85.—*V. obtusifolia*, Jord. Rather infrequent. Mid-Perth, Kinross, and Ayr-

shire (G. Brown, sp.).—*V. ruralis*, Jord. Plentiful on railway embankment near Kinghorn, v.-c. 85.—*V. derelicta*, Jord. Not uncommon, but often larger than the type. Kinross and Mid-Perth.—*V. Lloydii*, Jord. Very common. Dumfries, Kirkcudbright, Kinross, Mid-Perth. Many specimens are large-flowered and are perhaps better referred to var. *insignis*, Drabble.—*V. lepida*, Jord. In old pasture, several places near Dunning.—*V. lutea*, Huds. Not uncommon on the Ochils, often extremely small and showing considerable range of colour between the type and var. *amoena*, Henslow.—*V. Curtisii*, Forster. Sand-dunes, Southerness, Kirkcudbright. Taller and more slender than *V. Pesneaui*, with narrower leaves, but the distinction between the two is difficult.—*V. Pesneaui*, E. G. Baker. Southerness sand-dunes. Typical plants, passed by Mr. Baker.

Geranium nodosum, L. A few plants of doubtful origin in a small plantation, Duncrub, Dunning.

Potentilla norvegica, L. A casual at Dunning station; not permanent.

Alchemilla argentea, G. Don (*A. conjuncta*, Bab.). Cottage gardens, Dunning; origin unknown.

Rosa involuta, Sm. Several bushes by the burn above the village and in quantity on the Ochils near Knowes, Dunning. In both stations the hybrid is associated with the parents.

Sedum Telephium, L. Dr. Lloyd Praeger, in his account of the genus, separates this into two sub-species: *S. purpureum*, Link., and *S. Fabaria*, Koch. The latter appears to be the prevailing form in Mid-Perth and Kinross, and Dr. White (Flora of Perthshire, p. 146) states that all the specimens he examined seemed to belong to var. *Fabaria*.

Callitriche stagnalis, Scop. A common plant showing considerable variation. Well-grown specimens from a deep ditch west of Dunning were commented upon by Mr. Bennett: "This is a capital example of foliage. Had this been collected south of Yorkshire and sent *without* fruit, one would at once have said, trusting to leaves alone, *C. obtusangula*, Le Gall." The variety *serpyllifolia*, Lönnr., which is not infrequent, seems to be connected with the type by all gradations, and it may be a state rather than a true variety.—*C. intermedia*, Hoffm. (*C. hamulata*, Kuetz.). This is also extremely variable. A large form from the River Earn seems referable to *latifolia*,

Gilibert, if it is not simply a luxuriant state. Var. *pedunculata*, DC., by some retained as a species, is not so common as the type. It occurs here and there on gravel by Leadketty Burn, Dunning. Var. *homoiophylla*, Gren. et Godr., given specific rank by Williams (Prod. Fl. Brit., p. 509), under the name *C. angustifolia*, Hoppe, occurs in the same burn. I have not seen this variety in fruit.—*C. autumnalis*, L. Plentiful in Keltie Loch and Keltie Pond, Dunning, as a smaller form than usual.

Lythrum Salicaria, L. A local plant in Perthshire; recorded for Crieff neighbourhood, Lowland Earn, and now established lower down the river near Aberuthven.

Galium palustre, var. *elongatum* (Presl). River Earn, near Dalreoch Bridge.

Linnaea borealis, L. In my former notes, reference is made to the Duncrub station mentioned in White's Flora of Perthshire. The plant has certainly disappeared from this locality, no doubt as a result of recent changes in the woodlands.

Solidago Virgaurea, var. *cambrica*, Huds. Craig Rossie, Dunning, at about 1000 feet.

Aster Novi-Belgii, L., and *Tanacetum vulgare*, L., are not infrequent on the banks of the Earn.

Hieracium stictophyllum, Dahlst. (*fide* Druce). Several plants, rocky ground near Loch Arienas, Morven, v.-c. 97.

Campanula rapunculoides, L. Railway embankment west of Dunning Station, probably an escape from cultivation.

Phyteuma spicatum, L. has disappeared from the station mentioned in my former notes.

Verbascum Lychnites, var. *album*, Mill. A casual at Duncrub, Dunning.

Mentha longifolia, var. *nemorosa*, Willd. Quite established in several places near Dunning.—*M. spicata*, L. (*M. viridis*, L.). Banks of the River Earn.—*M. aquatica*, var. *minor*, Sole. Kirklands, Dunning. Var. *major*, Sole. Not infrequent, and common at the Whitemoss Loch.—*M. verticillata*, Huds. (*M. sativa*, L.). Since this represents *aquatica*×*arvensis*, considerable variation may be expected, and it is doubtful if any useful purpose is served in trying to attach varietal names to an extensive series of hybrid forms. Of hundreds of specimens examined, some seemed referable to var. *ovalifolia*, Opiz, and others apparently matched var. *acutifolia*, Sm..

but many failed to agree with any of the numerous varieties that have been described.—*M. arvensis*, var. *Nummularia*, Schreb. Fields west of Dunning.

Polygonum heterophyllum, Lindm., and *P. aequale*, Lindm., constitute the common sub-species of the aggregate *P. aviculare* in Perth and Kinross.—*P. heterophyllum*, var. *boreale*, Lindm., associated with *Ranunculus reptans*, L., on the sandy shore of Loch Leven looks distinct, the succulence of the leaf being quite pronounced.

Rumex Hydrolapathum, Huds. River Earn, near Aberuthven. A gratifying extension in the range of this local plant in Perthshire.

Potamogeton polygonifolius, Pourr., var. *cordifolius*, C. & S. Cow's Moss, Dunning.—*P. decipiens*, Nolte. The Earn specimens come under var. *latifolius*, Hagst., but leaf-size is no certain mark of distinction in this genus.—*P. perfoliatus*, L. The type is common in the Earn. A state with very small leaves and short internodes occurs in the Whitemoss Loch.—*P. crispus*, L., var. *planifolius*, Meyer. River Earn, about a mile above Dalreoch Bridge.—*P. panormitanus*, Biv. Keltie Pond, Dunning. Passed as a form of *pusillus* until Hagström in his recent researches drew attention to the differences between the two species.—*P. trichoides*, Cham. et Schlecht. Whitemoss Loch. An addition to the list of Scottish plants. See Mr. A. Bennett's paper in Trans. Perth. Soc. Nat. Sci., vol. vi, p. 6, 1914.—*P. pectinatus*, L. A slender state. Discovered in Keltie Pond, Dunning, July 1919. Not an uncommon species, but hitherto unrecorded from Perthshire.

Zannichellia palustris, L. Keltie Loch. Very rare. See my note in Trans. Perth. Soc. Nat. Sci., vol. vii, p. 74, 1920.

Carex pulicaris, L., *f. montana*, Pugl. Turfy ground, Ben Ledi, 87 West Perth.

Additions to the Flora of Orkney, as recorded in Watson's "Topographical Botany," Second Edition (1883).

By Colonel H. H. Johnston, C.B., C.B.E., D.Sc., M.D., C.M., F.R.S.E., F.L.S.

(Read 19th April 1923.)

This paper forms a continuation of five papers on the same subject, one of which I read before the Scottish Natural History Society on 4th April 1895, and which was published in "The Annals of Scottish Natural History," No 15, pp. 173–181 (July 1895), and the other four before the Botanical Society of Edinburgh on 15th January 1914, 10th June 1920, 17th March 1921, and 20th April 1922, and which were published in the Society's "Transactions," vol. xxvi, pp. 207–217 (1914), and vol. xxviii, pp. 23–42 (1920), pp. 51–66 (1921) and pp. 98–117 (1922), respectively. Most of the plants mentioned in this paper were collected by me during the year 1922.

Before and after the publication of the second edition of Watson's "Topographical Botany," in 1883, several of the plants mentioned in the following list have been recorded from Orkney by me and other botanists; but as the value of botanical records is greatly enhanced by the possession of authentic specimens, I have included in this list the names of all specimens in my herbarium, which are either additional to or confirm doubtful records of the plants recorded from County No. 111 Orkney in the second edition of the above-mentioned book.

In the case of those plants which have already been recorded from Orkney, references are given in the following list, under each species and variety, to the books in which the records have been published. These records are principally contained in "A Tour through some of the Islands of Orkney and Shetland," in the year 1804, by Patrick Neill (1806); "Notice of some of the rarer Plants observed in Orkney during the Summer of 1849," by John T. Syme, Esq., published in the "Transactions of the Botanical Society of Edinburgh," vol. iv, pp. 47–50 (1850); "Florula Orcadensis—A list of plants reported to occur in the Orkney Isles," by H. C. Watson, Esq., F.L.S., published in "The Journal of Botany," No. xiii,

pp. 11–20 (January 1864); Annual Reports of the Botanical Exchange Club of the British Isles; "A new List of the Flowering Plants and Ferns of Orkney," edited by W. A. Irvine Fortescue, and published in "The Scottish Naturalist" (1882–1884); "Supplement to Topographical Botany," ed. ii, by Arthur Bennett, A.L.S. (1905); and "Flora Orcadensis," by Magnus Spence, F.E.I.S. (1914).

The nomenclature followed is that of the second edition of Watson's "Topographical Botany" (1883), except in the case of species and varieties which are not recorded in that work. In the latter case the nomenclature adopted is that of "The London Catalogue of British Plants," tenth edition (1908), except where otherwise stated. Non-native plants, which have become naturalised in Orkney, are distinguished by a * prefixed to the names, and the names of casuals are printed in italics.

Of the 23 species and varieties recorded from Orkney in the following list, 10 are native, 1 is naturalised, 4 are mere casuals introduced into Orkney through the agency of cultivation, and 8 were planted by man.

Abbreviations.

"Annals Scot. Nat. Hist."=The Annals of Scottish Natural History.
Bennett, "Suppl. Top. Bot."=Supplement to H. C. Watson's Topographical Botany, second edition. By Arthur Bennett, A.L.S. (1905).
"Bot. Exch. Club Report" (separate Reports by the Secretary and Distributor)=Report of The Botanical Exchange Club of the British Isles, at present called The Botanical Society and Exchange Club of the British Isles.
"Journ. Bot."=The Journal of Botany.
"Lond. Cat."=The London Catalogue of British Plants.
Neill, "Tour"=A Tour through some of the Islands of Orkney and Shetland, in the year 1804. By Patrick Neill, A.M., Secretary to the Natural History Society of Edinburgh (1806).
"Scot. Nat."=The Scottish Naturalist.
Spence, "Flora Orcadensis"=Flora Orcadensis. By Magnus Spence, F.E.I.S. (1914).
Watson, "Top. Bot."=Topographical Botany, second edition. By H. C. Watson (1883).

Corrections.

In "Trans. Bot. Soc. Edin.," vol. xxviii, part ii, p. 56 (1921), *for* "*Fuchsia Riccartoni*, Hort. Am. bor. Cult. (*fide* G. C.

Druce)," *read* "*Fuchsia macrostema*, Ruiz et Pav. (*fide* T. A. Sprague)."

In "Trans. Bot. Soc. Edin.," vol. xxviii, part ii, p. 57 (1921), *for* "Taraxacum spectabile, *Dahlst.*, *var.* maculigerum, *Dahlst.* (*fide* G. C. Druce)," *read* "Taraxacum nævosum, *Dahlstedt* (*fide* Hugo Dahlstedt)."

In "Trans. Bot. Soc. Edin.," vol. xxvi, p. 221 (1914), and Spence, "Flora Orcadensis," p. 132 (1914), the plants from the Links of Melsetter, erroneously recorded under "Gentiana campestris, *Linn.*," are Gentiana Amarella, *Linn.* (*fide* C. E. Salmon, August 1921).

Hesperis matronalis, Linn. (*fide* T. A. Sprague).—Rubbish heap at seashore, 10 feet above sea-level, Hamla Voe, Stromness Harbour, Stromness, Mainland, 7th July 1922, Henry Halcro Johnston. Not native. Rare. Plants in full flower on 7th July 1922 and in fruit on 14th October 1922. This species is cultivated in gardens in Stromness, from which plants of it have probably been thrown out with weeds and rubbish.

The aggregate species *Viola arvensis*, Murray, is recorded from Orkney in Watson, "Topographical Botany," ed. ii, p. 57 (1883), but the following segregate species is not mentioned in that book. The nomenclature followed for this segregate species is that of "The British Pansies," by Eric Drabble, D.Sc., F.L.S., reprinted from "The Journal of Botany," vol. xlvii (1909) :—

Group I.—arvenses.

Viola derelicta, Jordan, ap. Billot, "Fl. France et Allem." 101 (nomen) (*fide* W. G. Travis).—Border of an oat field, 60 feet above sea-level, Bigging, Birsay, Mainland, 8th September 1922, H. H. Johnston. Not native. A weed of cultivation. Common. Plants in flower, and sparingly in unripe fruit, and growing among *Viola tricolor*, Linn. Corolla small; two upper petals uniformly pale violet, or whitish-violet in different plants, or rarely in the same plant; two lateral petals white, each with 1–2 dark violet lines; lower petal white, with 5–7 dark violet lines, and a yellow base:

spur of lower petal dark purple, as long as the calycine appendages. Two lateral petals and lower petal turning pale yellow on drying. Confirms the record of this species from Orkney (Stromness, Mainland, 1900, Rev. E. S. Marshall) in Drabble, "The British Pansies," p. 21 (1909); "Annals Scot. Nat. Hist.," No. 73, p. 59 (January 1910); and "Trans. Bot. Soc. Edin.," vol. xxvii, p. 55 (1916).

POLYGALA OXYPTERA, *Reichb.* [=POLYGALA DUBIA, *Bellynck*] (*fide* C. E. Salmon).—Grassy cliffs at seashore, 10 feet above sea-level, Scapa, Saint Ola, Mainland, 25th July 1876 (the same specimen was identified as "POLYGALA DEPRESSA, *Wender*," by the late Dr. J. T. I. B. Boswell), and 5th July 1912, H. H. Johnston; natural pasture at edge of sea-cliffs, 50 feet above sea-level, Howequoy Head, Holm, Mainland, 20th August 1922, H. H. Johnston; and grassy banks at burnside, 110 feet above sea-level, Geo Burn, Germiston, Stenness, Mainland, 20th September 1922, H. H. Johnston. Native and rare at all of these three stations. Confirms the record of this species from Orkney (Rousay, July 1896, Miss Webb) in Bennett, "Suppl. Top. Bot.," p. 17 (1905). See "Annals Scot. Nat. Hist.," No. 56, p. 229 (October 1905); and Spence, "Flora Orcadensis," p. 9 (1914).

Medicago lupulina, Linn., var. *Willdenowiana*, Koch (*fide* G. C. Druce).—Gravelly ground round filter beds, 200 feet above sea-level, Kirkwall Waterworks Reservoir, near Hatston, Saint Ola, Mainland, 9th August 1920, H. H. Johnston. Not native. Rare. Plants in unripe fruit and sparingly in flower. Confirms the record of this variety from the same station on the same date, by Dr. G. Claridge Druce in "Bot. Exch. Club Secretary's Report for 1921," vol. vi, part iii, p. 378 (September 1922). *Medicago lupulina*, Linn., is recorded as a non-indigenous plant from Orkney in Watson, "Top. Bot.," ed. ii, p. 107 (1883), but the var. *Willdenowiana*, Koch, is not mentioned in that book.

[*Geum urbanum*, Linn.—Plantation of trees, 80 feet above sea-level, Binscarth, Firth, Mainland, 6th September 1922, H. H. Johnston. Not native. Plants introduced into Orkney in the latter half of the nineteenth century and planted at Binscarth, where they have multiplied and spread in the plantation of trees. This species is recorded from Orkney in "Annals Scot. Nat. Hist.," No. 26, p. 111 (April 1898);

Bennett, "Suppl. Top. Bot.," p. 31 (1905); and Spence, "Flora Orcadensis," p. 21 (1914); but, having been planted in an artificial plantation of trees, and being still confined to that plantation, it has no claim to be included in the flora of Orkney, any more than the exotic trees in the same plantation.]

[*Rubus spectabilis*, Pursh (*fide* D. K. Hughes).—Rocky ravine at waterfall, 120 feet above sea-level, Burn of Laro, Rousay, 24th May 1922, H. H. Johnston. Not native. Planted by man, but by whom I have not as yet ascertained. Ten shrubs, 4–7 feet high, in full flower, with large rose-pink petals, only seen by me at the Burn of Laro. This pretty-flowered Bramble is a native of North America, and, on 27th May 1922, I also saw it growing in a plantation of trees at Trumland House, Rousay.]

[*Rosa gallica*, Linn. (*fide* William Barclay).—Grassy bank at roadside on the outer side of a garden stone wall, 20 feet above sea-level, Castlegreen, Saint Ola, Mainland, 28th August 1922, H. H. Johnston. Not native. Planted by man both inside and outside the garden of Castlegreen House. Very rare. Plants sparingly in flower-bud. This species is recorded from the same station by Dr. G. Claridge Druce in "Bot. Exch. Club Secretary's Report for 1920," vol. vi, part i, p. 123 (September 1921), but, being merely a cultivated garden plant, it has no claim to be included in the flora of Orkney.]

[*Cratægus Oxyacantha*, Linn., *probably* (*fide* D. K. Hughes, who states that "it is not possible to decide in the absence of both flowers and fruit").—Near the edge of grassy cliffs at seashore, 50 feet above sea-level, Berstane, Saint Ola, Mainland, 19th October 1922, H. H. Johnston. Not native. Three shrubs, planted by man, only seen by me on the top of the highest part of the cliffs between Berstane Bay and Wideford Burn.]

[*Sambucus nigra*, Linn.—Whin and elder hedge, 50 feet above sea-level, The Loan, Gyre, Orphir, Mainland, 11th August 1879, H. H. Johnston; not native, planted by the late James Johnston of Coubister on 6th April 1841, plants in flower; and marsh, 80 feet above sea-level, between Fursan and the Burn of Woodwick, Evie, Mainland, 28th July 1922, H. H. Johnston, not native, planted by man along with a few bushes of *Salix viminalis*, Linn., forming a small clump of

low shrubs, none of which were in flower or fruit. In the Rev. Dr. George Barry's "The History of the Orkney Islands," p. 280 (1805), the Elder is recorded as growing "on rills in Hoy," where it still grows on the banks of Kirk Burn, near The Bu, but, as this species only grows in Orkney where it has been planted by man, it has no claim to be included in the flora of the county.]

The aggregate species TARAXACUM OFFICINALE, *Wiggers*, is recorded from Orkney in Watson, "Top. Bot.," ed. ii, p. 236 (1883), but the following five segregate species are not mentioned in that book :—

TARAXACUM BELLULUM, *Dahlstedt* (*fide* Hugo Dahlstedt).—Grassy banks at seashore, 5 feet above sea-level, Sweyn Holm, H. H. Johnston. Native. Rare. Plants sparingly in flower, and growing in an uninhabited and uncultivated island, used for grazing sheep on in summer. Dr. Hugo Dahlstedt informs me that this species also grows in Western Norway.

TARAXACUM JOHNSTONII, *Dahlstedt*, in "Botanical Exchange Club Secretary's Report for 1922," vol. vi, part v, p. 774 (May 1923) (*fide* Hugo Dahlstedt).—Crags on hillside, Green Hill, Rousay, 9th May 1884, H. H. Johnston. Plants in flower (the same specimen was identified as "TARAXACUM OFFICINALE, *Wiggers, var.* UDUM (*Jordan*)," by the late Dr. J. T. I. B. Boswell) ; natural shell-sandy pasture at seashore, 10 feet above sea-level, Links of Mirkady, Deerness, Mainland, 21st April 1922, H. H. Johnston, common, plants sparingly in flower on 21st April 1922, and sparingly in fruit on 23rd June 1922 ; wet grassy ditch-side, 20 feet above sea-level, Hall of Tankerness, Saint Andrews, Mainland, 24th April 1922, H. H. Johnston, common, plants sparingly in flower ; heathery and grassy hillside, 280 feet above sea-level, Syradale, Firth, Mainland, 9th May 1922, H. H. Johnston, common, plants sparingly in flower ; grassy cliffs at seashore, 10 feet above sea-level, west side of Walkmill Bay, Orphir, Mainland, 11th May 1922, H. H. Johnston, rare, plants in full flower ; rocky crags on hillside, 90 feet above sea-level, Frotoft, Rousay, 27th May 1922, H. H. Johnston, common, plants in full flower ; and grassy and sandy banks at seashore, 10 feet above sea-level, Sandside, Bay of Sandside, Graemsay, 8th July 1922, H. H. Johnston, rare, plants sparingly in

flower. Native at all these seven stations, in three different islands.

Taraxacum tanylepis, *Dahlstedt*, in "Botanical Exchange Club Secretary's Report for 1922," vol. vi, part v, p. 776 (May 1923) (*fide* Hugo Dahlstedt).—Natural stony pasture at seashore, 5 feet above sea-level, Sweyn Holm, 29th May 1922, H. H. Johnston. Native. Common. Plants in full flower, and growing in an uninhabited and uncultivated island, used for grazing sheep on in summer.

Taraxacum nævosiforme, *Dahlstedt* (*fide* Hugo Dahlstedt).—Grassy banks, Hoy, 9th July 1877, H. H. Johnston, plants in flower (the same specimen was identified as "Taraxacum officinale, *Wiggers*, *var.* udum (*Jordan*)," by the late Dr. J. T. I. B. Boswell); roadside, Gyre, Orphir, Mainland, 11th October 1880, H. H. Johnston, plants in fruit (the same specimen was identified as "Taraxacum officinale, *Wiggers*, *var.* udum (*Jordan*)," by the late Dr. J. T. I. B. Boswell); pasture, Burn of Ore, Waas, Hoy, 3rd June 1884, H. H. Johnston, plants in flower and fruit (the same specimen was identified as "Taraxacum officinale, *Wiggers*, *var. a.* Dens-leonis, *Desf.*," by the late Dr. J. T. I. B. Boswell); grassy banks at seashore, 10 feet above sea-level, Hamla Voe, Stromness Harbour, Stromness, Mainland, 12th May 1922, H. H. Johnston, plants in full flower; grassy banks at seashore, 10 feet above sea-level, Langskaill, Gairsay, 29th May 1922, H. H. Johnston, plants in full flower; moist natural pasture at seashore, 10 feet above sea-level, The Taing, Viera, 3rd June 1922, H. H. Johnston, plants in full flower: and rank natural pasture near seashore, 10 feet above sea-level, Kili Holm, near Egilsay, 7th June 1922, H. H. Johnston, plants in full flower. Native and common at all these seven stations, in five different islands. This species also grows in Sweden.

Taraxacum nævosum, *Dahlstedt* (*fide* Hugo Dahlstedt).—Grassy banks at seashore, 10 feet above sea-level, Hamla Voe, Stromness Harbour, Stromness, Mainland, 19th May 1920, and 12th May 1922, H. H. Johnston, plants in full flower on both dates; grassy banks at seashore, 15 feet above sea-level, Lower Whitehall, Stronsay, 15th June 1922, H. H. Johnston, plants in flower and fruit; and grassy banks at seashore, 10 feet above sea-level, The Ness, Papa Stronsay, 19th June

1922, H. H. Johnston, plants in flower and fruit. Native and common at all these three stations, in three different islands. This species also grows in the Færoes, Iceland, Norway, Sweden, and England.

Aster salignus, Willd. (*fide* J. Hutchinson).—Grassy banks at burnside, 10 feet above sea-level, Burn of Boardhouse, Birsay, Mainland, 18th September 1922, H. H. Johnston. Not native. One clump of plants, 7 feet long by 3 feet broad, in flower and undeveloped fruit, below the bridge and near houses at the seashore.

Calluna vulgaris, *Hull*, *var.* incana, *Reichb.*—Heath at the seashore, 20 feet above sea-level, Ha Wick, Waas, 5th June 1884 (plants not in flower or fruit), and 11th September 1922 (plants in full flower), H. H. Johnston. Native. Common. Stem and lower surface and margins of the leaves densely clothed with white hairs. Corolla light purple. This hairy variety of the Ling is recorded from the same station ("near the Berry, Walls"), by Mr. W. A. Irvine Fortescue in "Scot. Nat.," No. xlviii, p. 371 (October 1882), but without any varietal name. See Spence, "Flora Orcadensis," p. 45 (1914).

*Mentha sylvestris, *Linn.* [=*Mentha longifolia, *Huds.*] (*fide* Arthur Bennett).—Marshy burnside, 180 feet above sea-level, Shurton, Burn of Woodwick, Evie, Mainland, 28th July 1922 (plants not in flower or fruit), and 5th October 1922 (plants in flower-bud), H. H. Johnston. Naturalised. Rare. Fresh leaves with the aromatic odour of Horse-Mint. A new record for this species for H. C. Watson's county No. 111 Orkney.

[*Populus balsamifera*, Linn. (*fide* S. A. Skan). *Salix pentandra*, Linn. (*fide* S. A. Skan). *Salix viminalis*, Linn. (*fide* S. A. Skan).—Grassy banks at burnside, 130 feet above sea-level, Burn of Hillside, at the bridge on the Dovnby-Evie Road, Birsay, Mainland, 22nd September 1922, H. H. Johnston. Not native. All three species planted by man. Rare. Plants not in flower or fruit. *Salix viminalis*, Linn. (*fide* S. A. Skan), also from a marsh, 80 feet above sea-level, between Fursan and the Burn of Woodwick, Evie, Mainland, 28th July 1922, H. H. Johnston. Not native. Planted by man, along with a few bushes of *Sambucus nigra*, Linn., forming a small clump of low shrubs, none of which were in flower or fruit.]

Potamogeton rutilus, *Wolfgang* (*fide* Arthur Bennett).—Mud at bottom of shallow water in a loch near the seashore, 7 feet above sea-level, Loch of Ayre, Saint Mary's Village, Holm, Mainland, 19th August 1922, H. H. Johnston. Native. Common in the Loch of Ayre. Plants in full flower. A new record for this species for H. C. Watson's county No. 111 Orkney. Mr. Arthur Bennett, in a note dated 6th November 1922, writes as follows :—" P. rutilus, *Wolf.*=P. cæspitosus, *Nolte*. Your specimens come about half-way between the Swedish rutilus and the Schleswig-Holstein cæspitosus (of which I possess a specimen from Nolte himself). The turios (winter-buds) are just like what Hagström describes."

Catabrosa aquatica, *Beauv.*, *var. b.* littoralis, *Parn.* (name confirmed by Arthur Bennett).—Marshy shell-sandy edge of a swamp near the seashore, 20 feet above sea-level, Loch of Aikerness (now a swamp through drainage of the loch), Evie, Mainland, 6th October 1922, H. H. Johnston. Native. Rare. Plants sparingly in flower. Anthers pale yellow. This species is recorded from Orkney in Watson, " Top. Bot.," ed. ii, p. 486 (1883), but the *var. b.* littoralis, *Parn.*, is not mentioned in that book. The late Dr. A. R. Duguid, in his manuscript " Flora Orcadensis " (1858), records Catabrosa aquatica, *Beauv.*, from the Loch of Aikerness, but, no doubt, it was the *var. b.* littoralis, *Parn.*, he saw there, because I did not see the type of the species at that station. See " Journ. Bot.," No. xiii, p. 17 (January 1864) ; " Scot. Nat.," New Series, p. 110 (January 1884) ; " Annals Scot. Nat. Hist.," No. 33, p. 39 (January 1900) ; and Spence, " Flora Orcadensis," p. 88 (1914), where the *var. b.* minor, *Babington*, " Manual of British Botany," ed. i, p. 366 (1843) [=*var. b.* littoralis, *Parn.*], is mentioned as being more common in Orkney than the type of the species.

Brachypodium sylvaticum, *Roem. et Schult.*, *var. b.* glabrescens, *Syme* (*fide* Arthur Bennett).—Grassy cliffs at seashore, 30 feet above sea-level, Lingro, Scapa Bay, Saint Ola, Mainland, 24th August 1922, H. H. Johnston, plants in full flower ; and grassy cliffs at seashore, 50 feet above sea-level, Berstane, Saint Ola, Mainland, 19th October 1922, H. H. Johnston, plants in fruit. Native and common at both these stations. Brachypodium sylvaticum, *Roem. et Schult.*, is recorded from Orkney in Watson, " Top. Bot.,"

ed. ii, p. 501 (1883), but the *var. b.* GLABRESCENS, *Syme*, is not mentioned in that book. In the late Dr. A. R. Duguid's manuscript "Flora Orcadensis" (1858), this species is recorded as having been found at the seashore at Scapa and Berstane by Dr. Gillies and Dr. A. R. Duguid, but, no doubt, it was the *var. b.* GLABRESCENS, *Syme*, they found there, because I did not see the type of the species growing at either of these two stations. See "Journ. Bot.," No. xiii, p. 17 (January 1864); "Scot. Nat.," No. iii, New Series, p. 111 (January 1884); "Annals Scot. Nat. Hist.," No. 33, p. 42 (January 1900); Bennett, "Suppl. Top. Bot.," p. 108 (1905); and Spence, "Flora Orcadensis," p. 91 (1914).

Vegetative Propagation of Haemanthus hirsutus, Baker. By R. J. D. Graham and L. B. Stewart.

(Read 17th May 1923.)

Detached scale leaves of *Haemanthus hirsutus* placed on sand and given occasional water or left dry on a shelf in a glasshouse with an intermediate temperature were found to produce buds. On sand or shelf, development was equally good, and took place most readily from January to March. Scale leaves placed on sand in April remained fresh till January of the following year, when bud development started profusely. The buds form most generally on the abaxial side of the scale, more rarely on the adaxial side, and the development is independent of the surface of the scale exposed to light or moisture. Development always occurs on the younger portion of the scale towards the base, where buds form either singly or in colonies of four or five. The buds originate from the tissue of the scale and not from the stem, as was proved by cutting off the base of the scale, thus removing any traces of stem structure, which might have adhered to the scale.

Microscopic examination of the scale shows a limiting single-layered epidermis with thin cuticle. This is succeeded by many layers of parenchyma containing starch uniformly distributed. On the abaxial side of the scale extending up to the medianally placed vascular bundles the parenchyma is chlorophyllous. Development of the buds is initiated in the superficial layers of this chlorenchyma. Buds with three

leaves developed show only a connection extending to the third and fourth layer of the chlorenchyma, and at no time is there vascular connection between the buds and the vascular strands of the scale.

The first leaf of the bud is juvenile in character, consisting only of a circular swollen base. The cortical tissues of this leaf are chlorenchymatous and contain large starch grains. The second and third leaves are transitional, with minute projections representing the lamina. Their internal anatomy corresponds with that of the first leaf. The first and second leaves rapidly lose their contents and function as scale leaves. The fourth leaf shows a persistent small green lamina with characteristic ciliate margin.

The production of adventitious buds on scale leaves of various Monocotyledons has been described by Balfour,[1] and has been figured in *Ornithogalum thyrsioides* by Green.[2] It is of interest to record that by utilising for propagation buds developed artificially from the scales of *Haemanthus hirsutus*, early maturity is secured. Year-old plants so propagated show as much growth as four-year-old bulbs raised from seed.

The Propagation of Camphor by Stem Cuttings.

By Oona Reid, B.Sc. (With Pl. IX.–XI.)

(Read 18th October 1923.)

The camphor tree is usually propagated from seed, but commercially may be propagated by cuttings (1). Mr. L. B. Stewart at the Royal Botanic Garden, Edinburgh, discovered that by using etiolated branches he could accelerate the rooting of these cuttings considerably. A series of experiments was made with normal and etiolated shoots and the results give conclusive evidence that such is the case.

To secure etiolated shoots two large cheese-cloth bags lined with brown paper were made and tied securely over two of the top branches of a camphor tree, 30–40 feet high, excluding light but leaving ample room for the development of the portions of the enclosed branches.

[1] Balfour, J. H. : Class Book of Botany, 1854, p. 657.
[2] Green, R. : Manual of Botany, 1904, p. 34.

Experiment I.—One of the bags was removed after fourteen days, and five cuttings, 6 inches–12 inches (seven to twelve internodes) in length were made, using the terminal portion of the most actively growing shoots. These were placed in the propagating pit, temp. 60° F., along with a control of similar cuttings from a normal branch. Two days later it was found that while the normal slips became flaccid and cast a considerable number of leaves, the etiolated lost less turgidity and no leaves, although during the time the shoots were in the dark a certain percentage of leaves were shed. On the sixth day callus formation was evident on the shortest etiolated cutting, *i.e.* the youngest internode through which a cutting had been made, and by the end of fourteen days the etiolated cuttings had all with one exception formed callus. The controls only showed callus in one case, and then only after twenty-eight days, and to a very slight extent (fig. 1).

Experiment II.—The second bag was left on for twenty-eight days, and by doubling the time the branch was more noticeably etiolated than in the first experiment, in that the stems were winged, the internodes longer, the leaves reduced in size and blanched. Terminal cuttings were made of the etiolated and of the normal stems 4–6 inches in length, as in the previous experiment, but this time the number of internodes was noted and never exceeded six, while those of the first bag varied from seven to twelve. Callus appeared on the fourth day onwards on 75 per cent. of the etiolated, and two days later on the same percentage of the control cuttings, but in subsequent development the amount of callus produced on the individual etiolated shoot greatly surpassed that produced on the normal.

Experiment III.—Cuttings were made of the normal stem at the 12th internode, with the terminal 4th–6th nodes removed. These were placed in the propagating pit under an inverted flower-pot with the hole closed. By the end of a week callus formation was visible at the apices of the cuttings, *i.e.* about the 4th or 6th internode of the whole shoot (fig. 2).

These experiments thus show that etiolation appreciably hastens callus formation, especially in older stems; that a smaller proportion of the more etiolated branches form callus, the optimum time of etiolation having probably been exceeded;

and that under favourable conditions callus forms more readily at the younger parts of the stem.

Investigation of the internal anatomy of the normal stem, of the same age as that used for propagation, was carried on simultaneously. Camphor, like the other Laurineae, shows quite a normal arrangement of stem tissues, the most noticeable feature being a continuous stereom in the pericycle. This was found to consist of crescent-shaped patches of prosenchymatous elements opposite the phloem, joined by a single layer of **U**-shaped stone cells (2). It was particularly noticed that although the cell walls gave all the lignin reactions, the cells themselves still retained their protoplasmic contents (fig. 3).

A series of sections was made from the 1st to the 10th node, in order to trace the process of development of the stereom in the normal stem. No lignification is evident till after the 2nd node, and then only in the xylem vessels to a slight extent. About the 3rd node slight lignification appears in the pericycle, in the form of small patches opposite the phloem, gradually increasing and finally linking up, by means of stone cells, between the 6th and 8th nodes.

In the case of the stem etiolated for fourteen days, no lignification is visible in the pericycle till the 6th node is sectioned, although the vessels of the xylem show lignification after the 3rd node; and even at the 8th node the crescentic patches are small in size and discontinuous, no stone cells being visible. A detailed examination of the individual cells shows reduction in thickness of cell wall with a corresponding increase in protoplasmic content (fig. 4).

During this partial etiolation, the pericyclic stereom invariably present at the 6th internode of the normal stem becomes transformed into thin-walled parenchyma. The change is gradual, and at the 8th–10th internodes lignification still persists, but never in a continuous ring.

Sections were made of etiolated cuttings in every stage of callus formation. In fig. 5 division is most active in the cambium and inner cortex, where it is seen giving rise to a large pad of callus, which will spread to cover the entire wounded surface. Cuttings four days old show a well-formed callus ring with a central discoloured pith. Fig. 6 shows necrotic pith cells with discoloured cell walls extending for a distance of 6–8 mm. from the wound. The pith cells

adjacent to the xylem are living and are in an active state of division, the divisions being laid down at right angles to the wounded surface, differing in this respect from those described by Sorauer (3), which are laid down parallel to the cut surface.

This development corresponds with that described by Stoll (4) for *Hibiscus Reginae*, *Passiflora quadrangularis*, and *Giselina littoralis*, viz. " That every tissue of the plant excepting true wood, bast and epidermal cells, is capable of aiding in the construction of callus, the initial and chief growth being from the cambium." Cell division was also found in the pericycle and inner cortex as described above. As described by Simon (5) for *Populus*, spp., it is impossible here also to separate cambial and cortical callus, because it is formed simultaneously by divisions parallel to the wounded surface. The activity of the medullary meristem, coupled with the growth from the cambial, pericyclic, and cortical meristems, results in the closing of the wounded surface.

Important questions arising out of this investigation are, firstly, what has become of this pericyclic stereom during etiolation? and, secondly, why should callus formation proceed more easily in its absence? There is no reason to suppose that the process of lignification is irreversible as long as the cell in question remains alive. The answer to the first question then depends on what is the acknowledged function of lignified tissue. Is it purely mechanical, or may it not act also as a form of reserve food, accumulated and laid down only under tonic conditions? If so, the problem is simplified, for naturally during the process of etiolation the plant would have to depend on its internal reserves. Regarding the second question, it is recognised that any undifferentiated tissue capable of rapid divisions may become meristematic, under given conditions, and form callus, and as cell division is evident in the pericycle, this tissue is able to contribute when in a non-lignified condition. It seems reasonable to suppose then that callus formation would proceed more easily in the absence of a lignified pericycle, which might present a formidable barrier to movement of reserve, and to growth in thickness, as the chief growth of callus takes place in the cambium.

This paper in no way aspires to deal fully with a subject in which there are so many possibilities. The effect of etiolation on the natural oils, on the translocation of food, etc.,

has yet to be worked out before the topic can be in any sense of the word completed.

Finally, I wish to thank Professor W. Wright Smith, Regius Keeper of the Royal Botanic Garden, Edinburgh, for providing facilities for carrying out the investigation.

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(3) Sorauer, P. : Physiology of Plants, Trans. Weiss., 1895.
(4) Stoll, R. : Über die Bildung des Kallus bei Stecklingen, Bot. Zeit., xxii, 1874.
(5) Simon, S. : Experimentelle Untersuchungen über die Differenzierungsvorgänge in Callusgewebe von Holzgewachsen, Jahr. wiss. Bot., xlv, 1908.

EXPLANATION OF PLATES IX.–XI.

Fig. 1. Cuttings nine weeks old, made at 10–12 internodes. Heavy callus formation is visible on the etiolated shoot on the left, while the normal shoot on the right has no callus visible, $\times\frac{1}{2}$.

Fig. 2. Cuttings ten days old of normal shoots which are etiolated under an inverted flower-pot, forming callus at the apex about the 4th internode, $\times\frac{1}{2}$.

Fig. 3. Transverse section of normal stem, 7th–8th internode, with crescents of pericyclic stereom opposite the phloem joined by stone cells. The lignified cells show protoplasmic contents, $\times 175$.

Fig. 4. Transverse section of etiolated stem, 7th–8th internode, showing the now thin-walled cells of the pericycle with large protoplasmic contents in striking contrast with the character before etiolation in fig. 3, $\times 175$.

Fig. 5. Longitudinal section of etiolated cutting five weeks old, showing formation of callus by meristematic activity of cambium, $\times 68$.

Fig. 6. Longitudinal section of etiolated cutting five days old, with the pith cells in active division, the new cell walls being laid down at right angles to the cut surface, $\times$ 175.

Fig. 1.

Fig. 2.

O. Reid. [*Photo. A. R. Easton.*

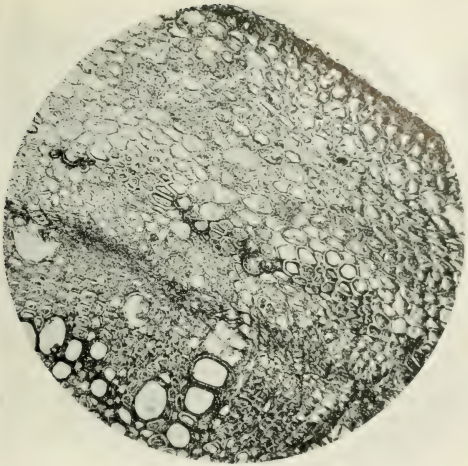

Fig. 3.

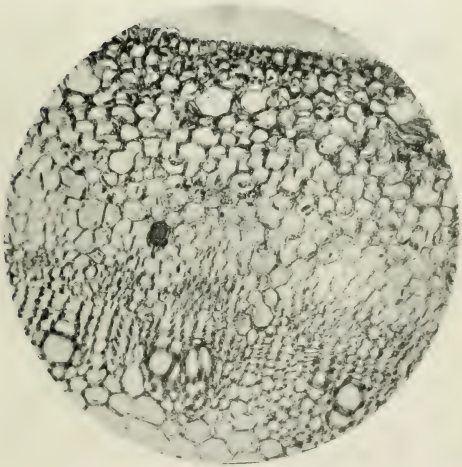

Fig. 4.

O. Reid. [*Photo. A. R. Easton.*

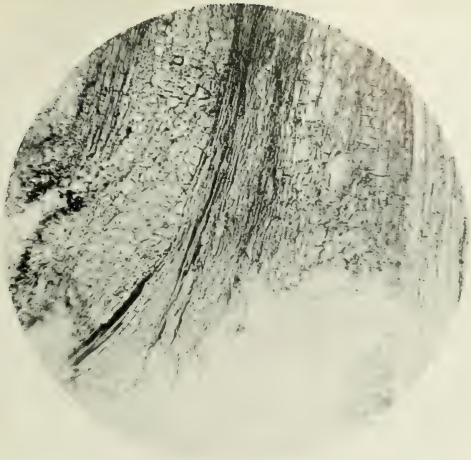

Fig. 5.

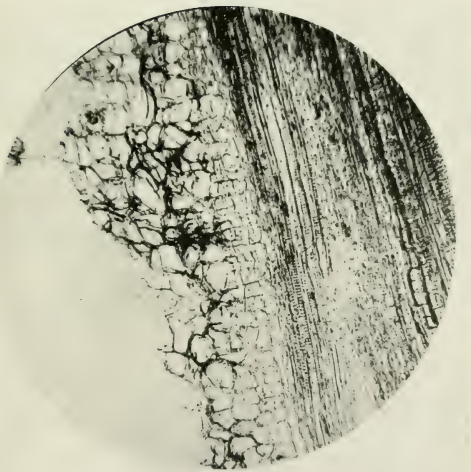

Fig. 6.

OBITUARY NOTICES.

William Evans, 1851–1922.

"He was perhaps the most competent Scottish field naturalist of his day, a man whose sympathies ranged over the whole field of wild life and whose knowledge was equally precise concerning the animals and the plants of the countryside from the lowest to the highest orders."

The words are those of one who knew him well, and had it not been that the appreciation of William Evans from the pen of Dr. Ritchie turns mainly and naturally on the zoological side, I should have transcribed it entire and untouched to these pages of Botanical Transactions.[1]

Yet in Botany, as in Zoology, William Evans was a man of wide interests, not confining himself to any single group of plants, but making himself thoroughly acquainted with all, possessing, indeed, an intimate knowledge of the lower as well as of the higher forms.

The love of plants had an opportunity to develop early, for it was in the atmosphere of the garden that William Evans spent his youngest days. His father, William Wilson Evans, was Curator of the Caledonian Horticultural Society's Experimental Garden in Inverleith Row, Edinburgh, which was later absorbed in the Royal Botanic Garden, and there William Evans, the second youngest of a family of six, was born on 9th May 1851. His early years in the old Experimental Garden were followed by boyhood spent in an environment close to Nature. With his father at Tynefield Farm, near East Linton, whither he had removed in 1857, and later with his uncle at Buckstone Farm, near Mortonhall, the boy came into touch with those influences which seem to have determined the nature and character of his life-work. Before he was ten years of age, he had expressed his interest in bird life in a series of miniature models of birds cut with his pen-knife in wood and painted in colours with his own brush. As a boy, this making of models was one of his favourite occupations. The subjects of his study varied, but in every case there is expressed at this early age that intense devotion

[1] "William Evans, F.R.S.E.," by James Ritchie. The Scottish Naturalist, 1922, pp. 169–173.

to accuracy and detail which marked every piece of work Mr. Evans performed.

About the age of sixteen or seventeen he was still at Edinburgh Institution, walking there every day from his uncle's farm, where he was residing at the time. He left school to join the Scottish Widows' Fund, and it was at the commencement of this professional career that he attended Professor John Hutton Balfour's botany class which met at the Botanic Garden at 8 a.m. The walk from Buckstone had to be accomplished before that early hour of meeting, and work in the laboratory was followed by professional duties in the office. Long walks became so much a habit in Evans' young life that after leaving Buckstone to take up residence in Edinburgh, he climbed Arthur's Seat every evening in order that he might feel he had had exercise for the day. Until ill-health compelled him to retire in 1892, Mr. Evans devoted himself wholeheartedly to his actuarial work, becoming a Fellow of the Faculty of Actuaries and publishing several important papers on actuarial science.

But the naturalist was dominant within him, and from 1880, when he was elected a Fellow of the Royal Physical Society, there appeared from his pen a steady stream of records and observations, all alike stamped with characteristic care and precision. John Hutton Balfour early recognised his worth and recommended Evans for election as an Associate of the Botanical Society of Edinburgh when he was no more than twenty years of age. That honour remained dear to him; he preferred it to ordinary membership, even though it debarred him from occupying the presidential chair which would have been his had the rule allowed. Other honours fell to him. Of the Royal Physical Society he became in turn Secretary, Vice-President, and President. Of the Royal Society of Edinburgh he was elected a Fellow in 1884, and for many years he shared the duties and responsibilities of editing The Scottish Naturalist, while its forerunner, The Annals of Scottish Natural History, owed much to his constant help and advice.

The years of retirement made possible that open-air life which sufficiently restored his health to allow the prosecution of those field studies which lay to his heart. Scottish Natural History has had few more devoted or more enthusiastic students, and few have equalled him in his painstaking search

after facts. His published papers run to well over 100, while short notes exceed 500 in number. Running through this long and extensive series of publications there is a guiding and connecting thread, for the aim of the author was a complete faunal survey of the area of the Forth—an area which William Evans made peculiarly his own, becoming the acknowledged authority on the animal life of the district. In his presidential address on "Our Present Knowledge of the Fauna of the Forth Area," delivered in 1906 to the Royal Physical Society, he summarised the species of animals known to occur in the district, giving the total number as 6865, of which he had met with no fewer than 4250 in the course of his own investigations.

His botanical papers were relatively few in number, and most of them have appeared in the Transactions of our Society. He did not count himself a botanist—such was his great modesty—yet he knew his plants well, both phanerogams and cryptogams. Mosses and Hepatics interested him especially, and the Ricciae of the Edinburgh District were dealt with in a paper published in Trans. Bot. Soc. Edin., 1907. Mosses and Hepatics from the Isle of May were recorded in 1908, with additions in 1910, while a long paper giving moss records for Selkirk, Peebles, and the Lothians was published in 1917. A further contribution in 1921 dealt with mosses from St. Kilda. His last public appearance was at a meeting of the Society on 18th May 1922, when he read a note on the occurrence of *Anthoceros punctatus*, L., in West Lothian, hitherto unrecorded from that county. Even during his last illness his interest in natural history continued to the very end, and he had in hand numerous zoological and botanical studies, including a list of the larger fungi of the Edinburgh district.

With a wealth of information at his disposal, William Evans was ever ready to help, and, so close is the web of life, his expert knowledge was often of the utmost value on such economic matters of importance as the insect pests of timber and other inter-relationships in the world of living things. To the younger man in need of help or in search of information there was always extended that warm welcome which made him feel encouraged to carry on; and pervading all was that extreme modesty so distinctive of the man at all times. Such men are few, and the death of William Evans on Monday, 23rd October 1922, leaves a blank in our ranks which will be

difficult to fill, for the school of Scottish Field Naturalists to which he belonged is fast disappearing. He was among the last, but his name will always be remembered among the most eminent. J. R. Matthews.

Sir Isaac Bayley Balfour.

We have to deplore the loss of our most distinguished member, the ornament of our Society, the one who has done most for it. He was never outwith its circle. His father, Professor John Hutton Balfour, was one of the founders of the Society, and the son became a member at the age of nineteen, in May 1872. But his association with it was earlier than that date. His trend to botany was evinced in his boyhood, and his acquaintance with botany and with botanists was inevitable in his environment. The year of admission to the Society was that of his first contributions to its Transactions. He read in 1872 two papers: "Notice of New Localities for Plants near Edinburgh," and "Localities for Plants near Edinburgh." At first hand from his father he had the history of the early days of the Society and of the interesting circle of scientists who laid so well its foundations. In losing him we feel we have lost the last link which connects us with the inception of our Society, which is now rapidly nearing its centenary.

While thus mourning one who loomed so large in the annals of our own Society we have as botanists, as horticulturists, as arboriculturists to lament the passing of one who made a great figure in the wide field outside our own special activities as a Society. I do not propose to enumerate his works nor to sketch his career. With the broad outlines of these we are all more or less familiar. Appreciations more or less detailed have already appeared in scientific and other journals. What I thought more in keeping with this occasion, had time permitted, was to elicit from our members their own recollections, their own impressions, their own opinions of what he represented to them.

As in the old saying—the child was father of the man. Genius, according to some, is the capacity for taking pains. When inclined to nod assent to such a facile generalisation

Photo by] [*W. Crooke.*

PROFESSOR SIR ISAAC BAYLEY BALFOUR.

we are faced with exceptions which raise the question afresh. Here we have the record of a youth scarcely out of his teens, an Arts Graduate, a Science Graduate, a Vans Dunlop scholar, a member of the Transit of Venus Expedition, a medical student who during his father's illness conducts the Botanical Classes with entire responsibility, and is never put out of his stride, graduates in Medicine in due course, without haste, without rest, and far did he travel. Such a one comes almost fully panoplied—no mere gift of taking pains. I do not know that he was addicted to taking pains in the narrow sense, his mind was a solvent of power with keen insight and driving force.

He was gifted with a sound constitution. I confess I knew him not in his prime, not till the middle "forties." But an excursion to a Highland Ben with Balfour in the closing years of last century was a thing to be remembered. Like his brother botanist Trail, he led the way at the pace and with the endurance of a hill shepherd. What corner of Scotland did he not traverse, and what a vivid recollection of the exact locality of the wanted species! And this was no mere record of isolated facts which he kept in store, but a picture of the grouping, of the relationships, to which a detailed study of the ecology could add but little. From his tours abroad he brought the same complete conspectus, the facts seemed mirrored in his brain, the individual plants were all linked in their associations.

His advent on the scene was at a happy hour for Botany. The whole science was in process of change. The old conception of a great botanist was one who knew the Latin names of many plants. The age of aridity of systematic Botany in its least alluring guise was rapidly disappearing. The botanist was previously in danger of becoming a traditional type—what Schleiden satirised as a merchant of Latin and a collector of dried hay. Balfour's acquaintance with the older school was profound. From it he took what was best, but it never dominated his outlook. It gave him instead one more angle from which to view the broad expanse of nature's workings. His association in early years with Strasburger, with Sachs, with de Bary was of great moment in his fashioning. It led him to the establishment of the Laboratory as the essential scientific need of the day. He was a great

lecturer, but he was not induced by his facility there to overestimate the importance of the *ex cathedra* discourse. The practical class, formerly an optional excrescence, became the chief of his weapons. With what unfailing assiduity did he pursue his goal! With now and again a set-back, his persistence gave us what is probably the best-equipped botanical Laboratory in these isles. And his teaching developed *pari passu*.

Susceptible to all the new influences, retentive of what was best in the old, he took his course amidst the changes of his eventful epoch with a sure and steadfast sanity. He was never lost in mere detail. He was ever seeking the thread which was to prove the guide through the maze. He was an exponent of the *big things* of his science, for he was of the breed of the great generalisers. And not of those who generalise before they have been through the mill in which details are ground. Darwin had the broad outlook, but he served his apprenticeship at "minutiæ," nor was that training lost. So Balfour in his Rhododendron papers saw deep, noted much of what might seem trivial distinctions, but he always came back to the wide survey. It was in this aspect that he appealed so much to his fellow-botanists. He was the Mentor—the Master of the Craft, if you like—to his botanical peers. It was a unique position. Some have published more, others may have made more profound discoveries, others proved "best sellers" in their lucid expositions, but amidst them all—it was, What does Balfour think of it? There was a clarity of judgment, an appreciation of evidence, a sanity too strong to be swayed by the "new thing" of the hour. And so it was that he who published much came to him for advice, that he who travelled much came for confirmation of his generalisations, that he who discovered much came to discuss the effect and bearings of what he had found on what was known.

An enormous worker, he taxed his own good constitution to the uttermost. When engaged on a task which held his interest his ardour was extreme. Even in his failing years he held on, often for nights on end, till one, two, and three in the morning. Absorbed in his specimens, he was oblivious of time. Even to eye-fatigue he seemed impervious. It was always with him "more light." The number of lamps and

their high power were ever a source of protest and professional dismay to the officials who superintend these matters for the Government service. His workroom was "engined" like a submarine and usually a mass of specimens and paper. I think as he grew older his *ingenium perfervidum* grew greater. I confess I never knew any of us who could attempt to keep pace.

He had a Spartan devotion to duty. Illness or fatigue rarely caused him to stay his hand. A little more indulgence to himself, acquiescence in a little lower standard in the execution of his duties, these would have saved us the regret of his sudden passing. But that was not his way. Work or play, he was out to win, and no half-measures. If he exacted fair measure from his staff, he took over-measure upon himself. We have in this world our schools and schoolmasters, and as we survey the road we have travelled, our minds, and our hearts, do not dwell with happy memories on those who let us do as we liked, but rather far on those who held us to the course and knew us for what we were.

His works are an enduring monument of his possession of the useful qualities of force and tact. Short as was his time at Glasgow, he left his mark on both Laboratory and Botanic Garden. Short as was his period at Oxford, he saw the rejuvenescence of the Oxford Botanic Garden and the establishment of the Annals of Botany. He returned to Edinburgh in 1888. In the face of many adverse conditions, such as financial stringency in the matter of Government support, especially in the earlier years, he has transformed the place. Step by step, by tactful persistency, he has established the laboratories, extended the grounds, rebuilt the plant-houses. He has left the Edinburgh Botanic Garden as a Mecca of the Horticulturist. To many who knew him not as a botanist he appealed as a distinguished exponent of the gardening craft. His acquaintance with the plants of cultivation, his exact knowledge of their origin and how they came to the Botanic Garden, his experience of their needs and treatment would have served as more than adequate equipment for a curator who had spent his days on little else.

These notes are of too brief compass to permit of reference to all his other activities. His many students may prefer to recall him as he showed himself, vasculum on shoulder,

at a hill excursion, eager to make the most of a day in the open. On such occasions he revelled in anecdote and reminiscence as the party made their way homeward. He was full of humour, with much appreciation of the "Doric."

When he retired he asked no other boon than the strength to go on working. In spite of rapidly failing health he pursued his labours without ceasing. *Nulla dies sine linea.* When the need arose it did not seem possible to one of his temperament to husband his energies, and existence without the stimulus of hard work made no appeal to him. The members of this Society who knew him so well and who now have lost his fellowship will ever retain vivid memories of his personality, and will ever appreciate the aptness of the reference made to him by another pen—"the friend and counsellor of all that is best in British Botany."

W. Wright Smith.

ROLL

OF

THE BOTANICAL SOCIETY OF EDINBURGH.

Corrected to September 1923.

Patron:

HIS MOST GRACIOUS MAJESTY THE KING.

HONORARY FELLOWS.

BRITISH SUBJECTS (LIMITED TO SIX).

Date of Election.	
June 1923.	DRUCE, G. CLARIDGE, M.A., LL.D., 9 *Crick Road, Oxford.*
Nov. 1888.	DYER, Sir WILLIAM TURNER THISELTON, M.A., LL.D., K.C.M.G., C.I.E., F.R.S., *The Ferns, Witcombe, Gloucestershire.*
Dec. 1907.	FARMER, J. BRENTLAND, M.A., D.Sc., F.R.S., *Professor of Botany, Imperial College of Science and Technology, S. Kensington.*
June 1923.	PRAEGER, R. LLOYD, B.A., D.Sc., *National Library of Ireland, Kildare Street, Dublin.*
June 1923.	RENDLE, A. B., M.A., D.Sc., F.R.S., 28 *Holmbush Road, Putney, London, S.W.* 15.
Feb. 1912.	SCOTT, Dr. D. H., M.A., LL.D., Ph.D., F.R.S., *East Oakley House, Basingstoke, Hants.*

FOREIGN (LIMITED TO TWENTY-FIVE).

June 1902.	BRITTON, NATHANIEL LORD, *Director of the Botanic Garden, New York.*
June 1923.	CAMPBELL, Dr. DOUGLAS HOUGHTON, *Professor of Botany, Stanford University, California;—Corresponding Member, Dec.* 1905.
June 1923.	CHODAT, Professor Dr. ROBERT, *L'Université, Geneva.*
June 1923.	COULTER, JOHN MERLE, *Professor of Botany, University of Chicago;—Corresponding Member, Dec.* 1905.
Feb. 1911.	FLAHAULT, Dr. CHARLES, *Professor of Botany to the Faculty of Science, and Director of the Institute of the University, Montpellier.*
June 1923.	IKENO, Professor SEITTSIRO, Ph.D., *Agricultural College, Imperial University, Tokio.*
June 1923.	LECOMTE, Professor HENRI, *Muséum d'Histoire Naturelle, Paris.*
June 1923.	LOTSY, Dr. J. P., *Spaarne* 17, *Haarlem.*
June 1923.	MACDOUGAL, Dr. D. T., *Director of Department of Botanical Research, Carnegie Institution, Tucson.*

Date of Election.

June 1923. Massart, Professor Jean, *Directeur de l'Institut Botanique Léo Errera, Brussels.*
June 1923. Ostenfeld, Dr. C. H., *Professor of Botany and Director of the Botanic Garden, Copenhagen.*
June 1923. Osterhout, W. J. V., Ph.D., *Professor of Botany, Harvard University, Cambridge, Mass.*
Mar. 1895. Sargent, Charles S., *Professor of Arboriculture and Director of the Arboretum, Harvard;—Corresponding Member, March* 1878.
June 1923. Thaxter, Professor Roland, Ph.D., 7 *Scott Street, Cambridge, Mass.*
June 1902. Trelease, Dr. William, *University of Illinois, Urbana, Illinois, U.S.A.*
Mar. 1895. Vries, Dr. H. de, *Professor of Botany in the University, Amsterdam.*
Dec. 1885. Warming, Dr. Eugene, For.M.L.S., *Emeritus-Professor, Copenhagen.*
June 1923. Wille, Dr. J. N. F., *Professor in the University and Director of the Botanic Garden, Christiania.*
June 1923. Wilson, E. H., *Arnold Arboretum, Jamaica Plain, Mass.*

RESIDENT AND NON-RESIDENT FELLOWS.

No distinguishing mark is placed before the name of Resident Fellows who contribute annually and receive Publications.

* *Indicates Resident Fellows who have compounded for Annual Contribution and receive Publications.*

† *Indicates Non-Resident Fellows who have compounded for Publications.*

‡ *Indicates Non-Resident Fellows who do not receive Publications.*

Date of Election.

Dec. 1915. Adam, Robert Moyes, 17 *W. Brighton Crescent, Portobello.*
Feb. 1905. †Aiken, Rev. J. J. Marshall Lang, B.D., *The Manse, Ayton, Berwickshire.*
Nov. 1884. †Alexander, J. A., *Waverley, Rossmore Avenue, Parkstone, Dorset.*
Nov. 1914. Alexander, J. H., 8 *Chamberlain Road, Edinburgh.*
Dec. 1908. ‡Balfour, F. R. S., M.A., 39 *Phillimore Gardens, Kensington, London, W.*
Jan. 1905. *Bell, A. C. M., W.S., 4 *Randolph Place, Edinburgh.*
May 1891. *Berwick, Thomas, 56 *North Street, St. Andrews.*
Feb. 1919. †Blackburne, Cecil Ireland, Esq., *Valence, Westerham, Kent.*
May 1888. *Bonnar, William, 51 *Braid Avenue, Edinburgh.*
Jan. 1899. *Borthwick, A. W., O.B.E., D.Sc., 22 *Grosvenor Gardens, London, S.W.* 1.
Dec. 1886. *Bower, F. O., M.A., D.Sc., F.R.S., F.L.S., *Professor of Botany, University of Glasgow,* 1 *St. John's Terrace, Hillhead, Glasgow.*
Feb. 1870. †Bramwell, John Milne, M.D., "*The Hove,*" *Furze Hill Road, Torquay.*
April 1913. ‡Brebner, James, 2 *Scotswood Terrace, Dundee.*
Dec. 1906. †Bryce, George, D.Sc., *Rabaul, New Guinea.*
Nov. 1922. Buchanan, E. M., 9 *Strathfillan Road, Edinburgh.*
Nov. 1894. Buchan-Hepburn, Sir A., Bart., *Smeaton Hepburn, Prestonkirk.*
Dec. 1921. ‡Burns, W., D.Sc., *Bombay Agric. Dept., Poona, Bombay, India.*
Dec. 1915. Cadman, Miss Elsie, M.A., B.Sc., 19 *Rutland Square, Edinburgh.*
Feb. 1882. Caird, Francis M., M.B., C.M., F.R.C.S.Ed., *Professor of Clinical Surgery,* 13 *Charlotte Square, Edinburgh,*—Artist.
Nov. 1905. Campbell, Robt., M.A., D.Sc., *Geological Department, University of Edinburgh.*
Nov. 1922. Chalmers, Miss Agnes, B.Sc., 9 *Montpelier Park, Edinburgh.*
June 1873. *Clark, T. Bennet, C.A., *Newmills, Balerno.*
Dec. 1856. †Cleland, John, M.D., F.R.S., *Drumclog, Crewkerne, Somerset.*
May 1861. ‡Coldstream, Wm., B.A., I.C.S. (retd.), 69 *West Cromwell Road, London. S.W.*
April 1913. ‡Cooper, R. E., *Govt. Botanic Garden, Maymyo, Burma.*
Mar. 1900. *Cowan, Alexander, *Valleyfield, Penicuik.*
Feb. 1923. †Cox, E. H. M., 34 *Margaret Street, London, W.* 1.
Dec. 1915. *Craib, W. G., M.A., *Professor of Botany, Aberdeen.*
Dec. 1903. Davidson, J. Randolph, M.A., B.Sc., *School of Agriculture, Gizeh, Egypt.*
Dec. 1911. ‡Davidson, John, *Assistant Professor of Botany, University of British Columbia, Vancouver, Canada.*

Date of Election.

Dec. 1892. Day, T. Cuthbert, F.I.C., 36 *Hillside Crescent, Edinburgh.*
April 1914. Dodd, A. Scott, B.Sc., 20 *Stafford Street, Edinburgh.*
Nov. 1919. *Downie, Miss D. G., B.Sc., 1 *W. Stanhope Place, Edinburgh.*
May 1921. Drummond, J. Montagu F., B.A., F.L.S., *Director, Plant Breeding Station, Corstorphine.*
Dec. 1859. †Duckworth, Sir Dyce, Bart., M.D., LL.D., 28 *Grosvenor Place, London, S.W.*
Feb. 1917. †Eley, Charles, *East Bergholt Place, Suffolk.*
Nov. 1885. Elliot, G. F. Scott, M.A., B.Sc., F.L.S., *Drumwhill, Mossdale.*
Jan. 1883. *Evans, Arthur H., Sc.D., 9 *Harvey Road, Cambridge.*
Dec. 1905. *Evans, W. Edgar, B.Sc., 38 *Morningside Park, Edinburgh.*
Mar. 1890. Ewart, J. Cossar, M.D., F.R.SS. L. & E., *Professor of Natural History, University of Edinburgh.*
Feb. 1873. *France, Charles S., 13 *Cairnfield Place, Aberdeen.*
Jan. 1906. *Fraser, James, 18 *Park Road, Leith.*
July 1872. *Fraser, John, M.B., C.M., 54 *Great King Street, Edinburgh.*
Oct. 1920. *Galloway, R. Angus, M.C., B.Sc., 1 *Riselaw Road, Edinburgh.*
Mar. 1871. *Gamble, James Sykes, M.A., F.L.S., *High Field, East Liss, Hants.*
Dec. 1920. †Garriock, John, M.A., B.Sc., *Morgan Academy, Dundee.*
May 1874. ‡Geikie, Sir Archibald, LL.D., F.R.SS. L. & E., *Shepherd's Down, Haslemere, Surrey.*
Jan. 1887. *Gibson, A. H., 28 *Dalhousie Terrace, Edinburgh.*
May 1903. ‡Gilmore, Dr. Owen, L.R.C.P., L.R.C.S.E., 49 *Acre Lane, Brixton, London, S.W.*
Dec. 1907. Gourlay, Dr. W. Balfour, M.C., 7 *Millington Road, Cambridge.*
Nov. 1921. *Graham, R. J. D., M.A., D.Sc., *Dunalastair, North Inch, Perth.*
Jan. 1889. *Grieve, James, *Redbraes Nurseries, Broughton Road, Edinburgh.*
Jan. 1922. *Gray, Miss Helen I. Allan, M.A., B.Sc., 107 *Ferry Road, Leith.*
Mar. 1923. Gray, John H., M.A., B.Sc., 28 *Gillespie Crescent, Edinburgh.*
Dec. 1895. *Grieve, Sommerville, 21 *Queen's Crescent, Edinburgh.*
Feb. 1879. *Grieve, Symington, 11 *Lauder Road, Edinburgh.*
Dec. 1921. Guyer, R. Glode, 167 *Mayfield Road, Edinburgh.*
Nov. 1919. Hamilton, Ferguson, M.A., 14 *Spottiswoode Street, Edinburgh.*
Nov. 1914. ‡Harley, Andrew, *Blinkbonny, Kirkcaldy.*
April 1910. Harvey, Miss Elsie, 12 *Addison Terrace, Victoria Park, Manchester.*
Mar. 1913. †Hayward, Miss Ida M., F.L.S., 7 *Abbotsford Road, Galashiels.*
April 1886. Hill, J. Rutherford, Ph.C., *Secretary, Pharmaceutical Society,* 36 *York Place, Edinburgh.*
Feb. 1878. †Holmes, E. M., F.L.S., F.R.H.S., *Curator of Museum, Phar. Soc. of Great Britain, Ruthven, Sevenoaks, Kent.*
Mar. 1920. Howison, Andrew, M.A., B.Sc., 18 *Beresford Avenue, Leith.*
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Dec. 1921. Johnston, Charles S. S., *Erneston, Boswall Road, Edinburgh.*
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Dec. 1912. *Johnstone, James Todd, M.A., B.Sc., *Royal Botanic Garden, Edinburgh.*
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Feb. 1894. Novar, The Rt. Hon. Viscount, G.C.M.G., *of Raith and Novar, Kirkcaldy.*
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April 1883. *Paul, Very Rev. David, M.A., LL.D., D.D., *Carridale, Fountainhall Road, Edinburgh,*—Foreign Secretary.
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April 1887. Peyton, Rev. W. W., *Braeriach, Tan-y-Bryn Road, Llandudno, Wales.*
Nov. 1921. Phillips, John F. V., B.Sc., *Forest Research Station, Deepwalls, Knysna, C.P., South Africa.*
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Jan. 1915. *Pinkerton, A. A., *Adele Cottage, Loanhead.*
June 1891. †Prain, Sir David, M.D., C.I.E., F.R.SS. L. & E., F.L.S., 12 *Heathview Gardens, Putney Heath, London, S.W.* 15.
July 1884. *Rattray, John, M.A., B.Sc., F.R.S.E., *Tullyburn Terrace, Glasgow Road, Perth.*
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Mar. 1902. Sampson, Hugh C., B.Sc., *The Riding, Riding Mill on Tyne, Northumberland.*
Dec. 1922. Seaton, Ian W., B.Sc., *Plant Breeding Division, Ministry of Agriculture, Belfast.*
Dec. 1887. ‡Scott, J. S., L.S.A., 69 *Clowes Street, West Gorton, Manchester.*
June 1922. †Simpson, J. R., *The Limes, Selkirk.*
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Jan. 1902. *Smith, Professor W. Wright, M.A., *King's Botanist, Regius Keeper, Royal Botanic Garden, Edinburgh.*
Jan. 1890. *Somerville, William, Œc.D., B.Sc., F.R.S.E., *Sibthorpian Professor of Rural Economy*, 121 *Banbury Road, Oxford.*
Oct. 1914. †Stewart, Edward J. A., M.A., B.Sc., 8 *Manor Road, Jordanhill, Glasgow.*

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April 1921. Sutherland, John, C.B.E., 11 *Inverleith Row, Edinburgh.*
Feb. 1902. Tagg, Harry F., F.L.S., *Royal Botanic Garden, Edinburgh.*
Jan. 1913. ‡Tagg, M. H., 53 *Clayton Avenue, Wembley, Middlesex.*
Dec. 1922. Taylor, George Crosbie, B.Sc., 15 *Broughton Place, Edinburgh.*
May 1923. †Taylor, R. A., M.A., B.Sc., *Culloden Estates, Neboda, Ceylon.*
Dec. 1887. Terras, J. A., B.Sc., 40 *Findhorn Place, Edinburgh.*
April 1921. †Thompson, J. MacLean, M.A., D.Sc., F.L.S., *Professor, Department of Botany, University, Liverpool.*
Jan. 1909. Thompson, Miss Jean G., B.Sc., 19 *Pentland Terrace, Edinburgh.*
Dec. 1888. Turnbull, Robert, B.Sc., 43 *Windsor Road, Rathmines, Dublin.*
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July 1886. †Waddell, Alexander, *of Palace, Jedburgh.*
Nov. 1921. Walker, Miss Marion, M.A., 12 *Chancelot Terrace, Edinburgh.*
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Nov. 1921. *Watt, Miss Janet, 6 *W. Catherine Place, Edinburgh.*
Feb. 1901. Whytock, James, 15 *W. Savile Road, Edinburgh.*
Dec. 1922. Wilson, Miss Dorothy G., B.Sc., 54 *E. Claremont Street, Edinburgh.*
Feb. 1912. Wilson, Malcolm, D.Sc., *Brentknoll, Kinnear Road, Edinburgh.*
Mar. 1909. *Wilson, Thos., Ph.C., 110 *High Street, Burntisland.*
May 1873. ‡Wright, Professor R. Ramsay, M.A., B.Sc., *Red Gables, Headington Hill, Oxford.*
Jan. 1903. Young, William, *Fairview, Kirkcaldy.*
Jan. 1923. *Younger, Harry Geo., 21 *Grosvenor Crescent, Edinburgh.*

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Nov. 1910. Grieve, Miss Jean E., 11 *Lauder Road, Edinburgh.*
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Nov. 1922. Massey, Miss K., B.Sc., *Glenanore, Disley, Cheshire.*
Nov. 1922. Wilson, Miss M. J. F., *Masson Hall, George Square, Edinburgh.*

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Mar. 1886. Bennett, A., A.L.S., 5 *Thanet Place, High Street, Croydon.*
Jan. 1906. Harrow, R. L., *Royal Botanic Garden, Edinburgh.*
Feb. 1919. Johnson, Norman M., B.Sc., *Kinglassie Schoolhouse, near Cardenden, Fife.*
Dec. 1883. Richardson, Adam D., 19 *Joppa Road, Portobello, Midlothian.*
Jan. 1906. Stewart, L. B., *Royal Botanic Garden, Edinburgh.*

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Feb. 1910. Galletly, Mrs. Sarah H., 71 *Braid Avenue, Edinburgh.*
April 1902. Grieve, Mrs. Symington, 11 *Lauder Road, Edinburgh.*

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July 1879. Cheeseman, T. F., F.L.S., F.Z.S., *Curator of the Museum, Auckland, New Zealand.*
Dec. 1905. Cockayne, L., Ph.D., F.R.S., F.L.S., *Ngaio, Wellington, New Zealand.*
June 1902. Constantin, Dr. J., *Professeur au Muséum d'Histoire Naturelle, Paris.*

Date of Election.

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Dec. 1905. Fawcett, William, B.Sc., F.L.S., 76 *Shooter's Hill Road, Blackheath, London, S.E.*

Dec. 1905. Gravis, Auguste, *Professor at the University, and Director of the Botanic Garden, Liège.*

Mar. 1895. Guignard, Léon, *Membre de Institut, Rue du Val-de-Grâce* 6, *Paris.*

June 1902. Henriques, Julio A., *Professor of Botany in the University, and Director of the Botanic Garden, Coimbra.*

May 1891. Henry, Augustine, M.A., F.L.S., *Professor of Forestry, Royal College of Science, Dublin.*

June 1902. Maiden, J. H., *Director of the Botanic Garden, Sydney, N.S.W.*

Dec. 1905. Mattirolo, Dr. Oreste, *Professor of Botany in the University, and Director of the Botanic Garden, Torino, Piedmont.*

Dec. 1905. Miyabe, Dr. Kingo, *Professor of Botany, Hokkaido Imperial University, and Director of the Botanic Garden, Sapporo, Hokkaido, Japan.*

June 1902. Miyoshi, Manabu, *Professor of Botany in the Imperial University, Tokio.*

June 1902. Raunkiaer, Professor Christen, *Botanic Museum, Copenhagen.*

Dec. 1905. Rodway, Leonard, *Government Botanist of Tasmania, Hobart.*

Dec. 1905. Schröter, Dr. Carl, *Professor of Botany, and Director of the Botanical Museum, Zürich.*

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Druce, Dr. G. C., **xxxiv.**
Praeger, Dr. R. Lloyd, **xxxiv.**
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New Hon. Foreign Fellows—
Campbell, Prof. D. H., **xxxiv.**
Chodat, Prof. R., xxxiv.
Coulter, Prof. J. M., **xxxiv.**
Ikeno, Prof. Seittsiro, **xxxiv.**
Lecomte, Prof. Henri, **xxxiv.**
Lotsy, Dr. J. P., **xxxiv.**
Massart, Prof. Jean, **xxxiv.**
MacDougall, Dr. D. T., **xxxiv.**
Ostenfeld, Dr. C. H., **xxxiv.**
Osterhout, Prof. W. J. V., **xxxiv.**
Thaxter, Prof. Roland, **xxxiv.**
Wille, Prof. J. F. N., **xxxiv.**
Wilson, E. H., **xxxiv.**
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Burns, W., xxiii.
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Downie, Miss D. G., iii.
Drummond, J. Montagu F., xviii.
Galloway, R. Angus, xii.
Garriock, John, xv.
Graham, R. J. D., xxi.
Gray, Miss Helen I. Allan, xxiii.
Gray, John H., xxxiii.
Guyer, R. Glode, xxiii.
Hamilton, Ferguson, iii.
Howison, Andrew, vi.
Johnston, Charles, S. S., xxiii.
King, David, xxviii.
King, Miss Isabella M., **xx.**
Laing, Ernest V., xxi.
Lewis, Herbert M., xxxi.
M'Call, David, xxix.
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Moncur, David, xxiv.
Pealling, Robert J., iii.
Phillips, John F. V., xxi.
Rollo, Hon. Bernard F., xxxii.
Seaton, Ian W., xxxi.
Simpson, J. R., xxvi.
Smith, Miss Edith Philip, xxxi.
Sutherland, John, xvii.
Taylor, George Crosbie, xxxi.
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Templeton, James, iii.
Thompson, J. M'Lean, xvii.
Urquhart, Mrs. Douie, xxix.
Walker, Miss Marion, xxi.
Watt, Miss Janet, xxi.
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Burt, Miss C. C., xxix.
Cumming, Miss A. N., xxix.
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Henderson, Miss E. M., xxix.
Jardine, Miss Gertrude, xviii.
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PROCEEDINGS

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SESSION LXXXIV

OCTOBER 3, 1919.

JAMES WHYTOCK, Esq., President, in the Chair.

The following Office-Bearers were elected for Session 1919–1920:—

PRESIDENT.

JAMES WHYTOCK, Esq.

VICE-PRESIDENTS.

A. W. BORTHWICK, O.B.E., D.Sc.
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JAMES FRASER, Esq.
SYMINGTON GRIEVE, Esq.

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ISA MARTIN, M.A.
R. STEWART MACDOUGALL, M.A., D.Sc.
R. A. ROBERTSON, M.A., B.Sc.
W. G. SMITH, B.Sc., Ph.D.
MALCOLM WILSON, D.Sc., F.R.S.E., F.L.S.

Honorary Secretary—W. W. SMITH, M.A.
Foreign Secretary—The Very Rev. D. PAUL, M.A., D.D., LL.D.
Treasurer—ANDREW MASON, Esq., c/o RICHARD BROWN & Co., C.A.
Assistant-Secretary—J. T. JOHNSTONE, M.A., B.Sc.
Artist—Professor FRANCIS M. CAIRD, M.B., C.M., F.R.C.S.E.
Auditor—ROBERT C. MILLAR, C.A.

LOCAL SECRETARIES.

Bathgate—Robert Kirk, M.D., F.R.C.S.E.
Calcutta—Professor S. C. Mahalanobis, B.Sc., F.R.S.E., F.R.M.S., Presidency College.
Cambridge—Arthur Evans, M.A.
Croydon—A. Bennett, A.L.S.
East Liss, Hants—James Sykes Gamble, M.A., C.I.E., F.R.S.
Glasgow—Professor F. O. Bower, Sc.D., F.R.S., F.L.S.
London—William Carruthers, F.R.S., F.L.S.
„ J. F. Duthie, B.A., F.L.S.
„ E. M. Holmes, F.L.S., F.R.H.S.
„ Lieut.-Col. Sir David Prain, M.D., C.I.E., F.R.S., F.L.S., Royal Botanic Gardens, Kew.
Philadelphia, U.S.A.—Professor J. M. Macfarlane, D.Sc., F.R.S.E.
St. Andrews—Professor M'Intosh, M.D., LL.D., F.R.S.E.
„ Robert A. Robertson, M.A., B.Sc.
„ J. H. Wilson, D.Sc., F.R.S.E.
Toronto, Ontario—The Hon. W. R. Riddell, B.Sc., B.A., LL.D.
„ Professor Ramsay Wright, M.A., B.Sc.

The President intimated the death since last meeting of Professor William Gilson Farlow, an Honorary Foreign Fellow, of Professor J. W. H. Trail, a former President of the Society, and also of George Bird, a Resident Fellow and former Office-Bearer.

Mr. Symington Grieve made a statement on the threatened destruction of rare plants at Blackford Hill by the County Road Board removing for road metal the rock on which they grow. On his motion a resolution of protest was carried unanimously, and a copy ordered to be sent to the Town Council.

Captain W. Balfour Gourlay communicated Notes from Cannock Chase on *Vaccinium intermedium*, Ruthe, specimens of the hybrid and parent plants being shown (see vol. xxvii, p. 327).

The Hon. W. R. Riddell communicated a paper on the Pharmacopoeia of another Botanical Physician (see p. 1).

Dr. R. S. MacDougall read a paper on *Perrisia laricis* as an enemy of Larch cones, the attacks being destructive to seed.

Dr. R. S. MacDougall exhibited *Stephanitis Rhododendri*, a Tingid injurious to Rhododendron leaves, and also *Scolytus intricatus*, causing damage to an oak stem.

Dr. MALCOLM WILSON exhibited specimens of the aecidial stage of *Cronartium ribicola*, Dietr. (*Peridermium Strobi*, Kleb.), on *Pinus Lambertiana*, Dougl., from Murthly, Perthshire. This is the first record of the fungus on this host for Great Britain.

Mr. H. F. TAGG exhibited cultures of *Penicillium* showing zonation, and read some preliminary notes on them.

NOVEMBER 10, 1919.

JAMES WHYTOCK, Esq., President, in the Chair.

Mr. JAMES TEMPLETON, Mr. ROBERT J. PEALLING, and Mr. FERGUSON HAMILTON were elected Resident Fellows.

Mr. R. M. ADAM read a paper on Vegetation Records by Aerial Photography, in which an outline of the methods and apparatus employed was illustrated and described, and by a series of slides and descriptions the marked character of vegetation as seen from the air was shown, and the value of an aerial photograph as a means to record the vegetation was demonstrated. Attention was directed to the value of aerial photography to the forester, and the information obtainable from the air was discussed, photographs of woodland from the air being shown. Reference was made to its use in botanical survey, also its value when prospecting for timber over forest areas. Several large photographic maps of agricultural landscapes were exhibited, the slides shown being all of areas in Scotland, and two especially were notable, one of Lochnagar and the other of Glen Doll.

DECEMBER 11, 1919.

JAMES WHYTOCK, Esq., President, in the Chair.

Miss D. G. DOWNIE was elected a Resident Fellow.

The PRESIDENT intimated the death of the Rev. E. S. MARSHALL, an Honorary British Fellow of the Society.

Professor O. L. RICHMOND read a paper on the Floral Decoration on the Friezes of a Roman Altar of Peace, and

illustrated it with a large number of lantern illustrations with the object of identifying the plants which had served the artist for models. Many of the plants were too conventional for identification, but others could be referred to particular genera with some certainty.

Miss IDA M. HAYWARD read "Notes on the Adventive Flora of the Tweed," in which she dealt with aliens introduced through the woollen industry, and also exhibited a large number of specimens.

Dr. A. W. BORTHWICK exhibited specimens of *Caeoma pinitorquum* on the Scots Pine, and also of Douglas Fir twigs damaged by an insect.

Mr. J. M. MURRAY sent for exhibition specimens of Scots Pine, showing variations indicating the existence of "races" of the species, and also specimens of malformation of hazel catkin.

JANUARY 22, 1920.

JAMES WHYTOCK, Esq., President, in the Chair.

The TREASURER, Mr. ANDREW MASON, submitted the following Statement of Accounts for Session 1918–1919:—

INCOME.

Annual Subscriptions for 1918–1919	£26	15	0
Do. Arrears	5	10	0
Transfer from Life Members' Fund	10	13	2
Transactions sold	4	5	0
Diploma	0	5	0
Interest on Funds Invested and in Bank	8	1	1
Subscriptions to Illustration Fund	3	10	0
	£58	19	3

EXPENDITURE

Printing *Transactions* for 1918–1919	£55	19	6
Printing Notices for Meetings, etc.	8	3	6
Rooms for Meetings and Tea	4	1	0
Stationery, Postages, Carriages, etc.	3	8	10
Fire Insurance on Books, etc.	0	5	0
Honorarium to Secretary's Assistant	2	2	0
Do. to Treasurer	4	4	0
	£78	3	10
Excess of Expenditure over Income	£19	4	7

STATE OF FUNDS.

Life Members' Fund.

Balance of Fund at close of Session 1917–1918		£107 3 6
Add—Life compositions received		32 11 0
		£139 14 6
Deduct—Transferred to Income		10 13 2
Balance as at close of Session		£129 1 4

Ordinary Fund.

Balance of Fund at close of Session 1917–1918	£69 5 3		
Deduct—Decrease during Session 1918–1919	19 4 7		
Balance as at close of Session			50 0 8
Total Funds			£179 2 0

Being:—£100 5% War Stock, 1929–1947	£95 0 0		
Sum in Current Account with Union Bank of Scotland, Ltd.	21 5 0		
Sum in Deposit Receipt with do.	130 0 0		
	£246 5 0		
Less—Net Balance on outstanding Accounts	£64 3 0		
Due to Treasurer	3 0 0		
	67 3 0		
As above			£179 2 0

Note.—Subscriptions in arrear, considered recoverable: 1917–18, £2, 5s.; 1918–19, £4, 10s.

EDINBURGH, 10*th January* 1920.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1918–1919, and have found them correct. I have also checked the foregoing Abstract, and find it correct.

ROBT. C. MILLAR, C.A., *Auditor.*

The PRESIDENT announced the death of Sir THOMAS R. FRASER, and of JOHN H. WILSON, D.Sc., both Resident Fellows and former Office-Bearers.

Dr. A. W. BORTHWICK read a paper on "Roads of Remembrance," and the Planting of Ornamental and Memorial Trees.

Dr. R. S. MACDOUGALL read a Note on *Empusa* sp. as destructive to *Rhopalosiphum dianthi*, and also on *Pseudo-*

coccus gahani as an enemy of *Cereus viridiflorus*, and exhibited specimens of both.

Dr. MALCOLM WILSON exhibited a specimen of *Melasmia Empetri*, Magn., on *Empetrum nigrum*, Linn., collected on Creag na Caillich, Killin. There is little doubt that *Rhytisma Empetri*, Buchanan White, is identical with this species. Examination shows that no asci are present in Buchanan White's specimens, which were assigned to *Rhytisma* probably only on account of their external resemblance to that genus.

Mr. W. W. SMITH and Dr. J. SMALL exhibited a specimen of *Parasenecio*, a new genus of Compositae.

Mr. N. M. JOHNSON sent for exhibition sections of an abnormal ovary of Tulip.

FEBRUARY 19, 1920.

JAMES WHYTOCK, Esq., President, in the Chair.

Professor J. W. BEWS read a paper on the Vegetation of South Africa, in which he described the various vegetation regions of South Africa, and explained the different climatic and other factors which determine the nature of the vegetation. The paper was illustrated by a fine series of lantern slides, which were arranged to show the plant succession in the different regions, beginning with the semi-desert Karroo and central portion of South Africa. Natal and the Eastern side of South Africa were dealt with in detail. Economic questions were also touched upon and illustrated.

MARCH 18, 1920.

JAMES WHYTOCK, Esq., President, in the Chair.

Mr. ANDREW HOWISON was elected a Resident Fellow.

Professor BAYLEY BALFOUR communicated a paper on *Primula tapeina*, Balf. f. et Forrest, and some other Dwarf Suffruticose Primulas in Cultivation.

Dr. W. G. Smith communicated a paper on Some Oat Hybrids, which dealt with hybrids between the Chinese and Hungarian Oat, and specimens of the various crosses were exhibited.

Dr. Malcolm Wilson exhibited two new Fungi, *Labridium Rhododendri* and *Aecidium sino-Rhododendri*, on *Rhododendron calvescens*, Balf. f. et Forrest, collected by Mr. George Forrest in Tibet.

APRIL 8, 1920.

James Whytock, Esq., President, in the Chair.

Dr. B. D. MacCallum was elected a Non-Resident Fellow.

Dr. A. W. Borthwick showed a series of lantern slides on Forestry, and read a descriptive lecture as an example of a series which might be formed to aid in Forestry education, and invited criticism on the project. A discussion followed which was generally favourable to the scheme.

A large collection of Rhododendrons in flower were shown from the Royal Botanic Garden. The species exhibited were:—

R. Anthopogon, D. Don; *R. arboreum*, Sm.; *R. argenteum*, Hook. f.; *R. aeruginosum*, Hook. f.; *R. Augustinii*, Hemsl.; *R. Baileyi*, Balf. f.; *R. Benthamianum*, Hemsl.; *R. campanulatum*, D. Don; *R. campylocarpum*, Hook. f.; *R. charianthum*, Hutchinson; *R. chartophyllum*, Franch.; *R. ciliatum*, Hook. f.; *R. cuneatum*, W. W. Sm.; *R. Davidsonianum*, Rehd. et Wils.; *R. decorum*, Franch.; *R. fastigiatum*, Franch.; *R. flavidum*, Franch.; *R. fulgens*, Hook. f.; *R. glaucum*, Hook. f.; *R. haematochilum*, Craib; *R. hedyosmum*, Balf. f.; *R. hippophaeoides*, Balf. f. et W. W. Sm.; *R. Hodgsoni*, Hook. f.; *R. impeditum*, Balf. f. et W. W. Sm.; *R. intricatum*, Franch.; *R. Keiskei*, Miq.; *R. Kaempferi*, Planch.; *R. ledifolium*, G. Don; *R. lochmium*, Balf. f.; *R. longistylum*, Rehd. et Wils.; *R. lutescens*,

Franch.; *R. Metternichii*, Sieb. et Zucc.; *R. neriiflorum*, Franch.; *R. nivale*, Hook. f.; *R. oleifolium*, Franch.; *R. oreotrephes*, W. W. Sm.; *R. pendulum*, Hook. f.; *R. pseudo-yanthinum*, Balf. f.; *R. racemosum*, Franch.; *R. rhombicum*, Miq.; *R. rubiginosum*, Franch.; *R. scabrifolium*, Franch.; *R. scintillans*, Balf. f. et W. W. Sm.; *R. Searsiae*, Rehd. et Wils.; *R. serpyllifolium*, Miq.; *R. setosum*, D. Don; *R. sino-grande*, Balf. f. et W. W. Sm.; *R. Smithii*, Nutt.; *R. stereophyllum*, Balf. f. et W. W. Sm.; *R. sycnanthum*, Balf. f. et W. W. Sm.; *R. Thomsoni*, Hook. f.; *R. thyodocum*, Balf. f. et Cooper; *R. Valentinianum*, G. Forrest; *R. Veitchianum*, Hook.; *R. virgatum*, Hook. f.; *R. Wallichii*, Hook. f.; *R. yunnanense*, Franch.

MAY 13, 1920.

James Whytock, Esq., President, in the Chair.

The President announced the death of William Beaverley Cowie, F.C.S., a Resident Fellow.

Mr. William Young read a paper on Preliminary Notes for a Flora of Fife and Kinross, in which he indicated what had already been done in that field, and outlined his scheme for a complete flora of the two counties, and he appealed for assistance in carrying out the work.

Mr. M. Y. Orr exhibited abnormal Catkins of *Salix Mademii*, Boiss., from the Royal Botanic Garden.

JUNE 10, 1920.

James Whytock, Esq., President, in the Chair.

The President intimated the death of Professor Timiriazeff, an Honorary Foreign Fellow, and of Mrs. A. Dowell, a Resident Fellow.

Colonel H. H. Johnston communicated three papers: Additions to the Flora of Orkney as recorded in Watson's Topographical Botany, ed. 2 (see p. 23); Corrections to

"Notice of some of the Rarer Plants observed in Orkney during the Summer of 1849, by John T. Syme" (see p. 46); and Observations on "Notes on the Flora of the Orkney Isles, by Arthur Bennett, A.L.S." (see p. 43). A large number of rare and interesting plants from Orkney were also exhibited.

Dr. Malcolm Wilson exhibited specimens of Douglas Fir attacked by a species of *Phomopsis* (see p. 47), and also specimens of *Sirex gigas* and its Ichneumon, *Rhyssa persuasoria*, Linn., attacked by a species of *Isaria* closely resembling *Isaria floccosa*, Fr., which has been found on *Bombyx Jacobaea* in Britain.

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SESSION LXXXV

OCTOBER 21, 1920.

James Whytock, Esq., President, in the Chair.

The following Office-Bearers were elected for Session 1920–1921 :—

PRESIDENT.

W. G. Smith, B.Sc., Ph.D.

VICE-PRESIDENTS.

A. W. Borthwick, O.B.E., D.Sc.
James Fraser, Esq.
J. Rutherford Hill, Esq.
Malcolm Wilson, D.Sc., F.L.S., F.R.S.E.

COUNCILLORS.

Sir Archibald Buchan-Hepburn, Bart.
T. Bennet Clark, C.A.
Symington Grieve, Esq.
Col. H. H. Johnston, C.B., C.B.E., F.L.S.
Mrs. John Law.
Isa Martin, M.A.
R. Stewart MacDougall, M.A., D.Sc.
Sir John Stirling Maxwell, Bart.
R. A. Robertson, M.A., B.Sc.
James Whytock, Esq.

Honorary Secretary—W. W. Smith, M.A., F.R.S.E.
Foreign Secretary—Very Rev. D. Paul, M.A., D.D., LL.D.
Treasurer—Andrew Mason, Esq., c/o Richard Brown & Co., C.A.
Assistant-Secretary—J. T. Johnstone, M.A., B.Sc.
Artist—Professor Francis M. Caird, M.B., C.M., F.R.C.S.E.
Auditor—Robert C. Millar, C.A.

LOCAL SECRETARIES.

Aberdeen—Professor W. G. Craib, M.A.
Calcutta—Professor S. C. Mahalanobis, B.Sc., F.R.S.E., F.R.M.S., Presidency College.
Cambridge—Arthur Evans, M.A.
Croydon—A. Bennett, A.L.S.
East Liss, Hants—James Sykes Gamble, M.A., C.I.E., F.R.S.
Glasgow—Professor F. O. Bower, Sc.D., F.R.S., F.L.S.
London—William Carruthers, F.R.S., F.L.S.
„ J. F. Duthie, B.A., F.L.S.
„ E. M. Holmes, F.L.S., F.R.H.S.
„ Lieut.-Col. Sir David Prain, M.D., C.I.E., F.R.S., F.L.S., Royal Botanic Gardens, Kew.
Philadelphia, U.S.A.—Professor J. M. Macfarlane, D.Sc., F.R.S.E.
St. Andrews—Professor M'Intosh, M.D., LL.D., F.R.S.E.
„ Robert A. Robertson, M.A., B.Sc.
Toronto, Ontario—The Hon. W. R. Riddell, B.Sc., B.A., LL.D.

Mr. R. Angus Galloway was elected a Resident Fellow.

The President intimated the death since last meeting of John Gilbert Baker, F.R.S., an Honorary British Fellow, and of Robert Kirk, M.D., a Resident Fellow.

Dr. Malcolm Wilson read a paper on Two Diseases of the Douglas Fir, in which a new fungus, *Phomopsis Pseudotsugae*, was described (see p. 47), and *Botrytis Douglasii* was recorded on the Douglas fir for the first time in this country.

Dr. Malcolm Wilson and Mr. H. F. Tagg communicated a paper on *Physarum gyrosum* in Britain.

Dr. W. G. Smith exhibited specimens of a new Black-currant-Gooseberry hybrid which differed from previously described hybrids of similar parentage.

Mr. T. Bennet Clark exhibited specimens of the so-called Strawberry-Raspberry (*Rubus sorbifolius*, Hort.), of which other specimens were also shown by Mr. James Fraser.

Mr. James Fraser exhibited specimens of Ergot on *Alopecurus alpinus*, Sm., var. *robustus*, Druce, from Tweedside. Ergot on other grasses was also shown by Dr. W. G. Smith.

The following plants in flower were shown from the Royal Botanic Garden:—*Cirrhopetalum Farreri*, W. W. Sm.; *Columnea gloriosa*, Sprague; *Sedum pyramidale*, Praeger; *Spathoglottis Edinensis*, Hort. Edin. (S. pulchra × Fortunei); *Spathoglottis pulchra*, Schlechter; *Spathoglottis Fortunei*, Lindl.

NOVEMBER 18, 1920.

W. G. Smith, B.Sc., Ph.D., President, in the Chair.

Mr. M. Y. Orr read a Preliminary Paper on Bacterial Pockets in the Leaf of a species of *Dioscorea* from Nigeria, and exhibited specimens and cultures of the Bacterium in various media.

Dr. B. D. MacCallum exhibited specimens of coniferous wood infected with Blue Rot, the disease being caused by *Ceratostomella sp.* Other specimens of timber similarly discoloured by another fungus were shown by Dr. W. G. Smith.

Mr. J. R. Matthews exhibited a land form of *Utricularia vulgaris*, Linn., which is robuster than the type and has no bladders.

Mr. William Evans exhibited some original Drawings of Scottish Scenery by Dr. R. K. Greville, the author of Scottish Cryptogamic Botany, and a former President of the Society.

The following plants in flower were shown from the Royal Botanic Garden:—*Burbidgea nitida*, Hook. f.; *Euadenia eminens*, Hook. f.; *Gentiana rhodantha*, Franch.; *Primula Mooreana*, Craib; *Sophro-Cattleya eximea* ×; *Theophrasta Jussieui*, Lindl.

DECEMBER 16, 1920.

W. G. SMITH, B.Sc., Ph.D., President, in the Chair.

The TREASURER, Mr. ANDREW MASON, submitted the following Statement of Accounts for Session 1919–1920:—

INCOME.

Annual Subscriptions for 1919–1920	£30 10 0
Do. Arrears	4 10 0
Transfer from Life Members' Fund	10 16 4
Transactions sold	6 5 0
Interest on Funds Invested and in Bank	9 16 8
Subscriptions to Illustration Fund	2 1 0
	£63 19 0

EXPENDITURE.

Printing *Transactions* for 1919–1920	£51 8 5
Printing Notices for Meetings, etc.	18 5 0
Rooms for Meetings and Tea	10 6 6
Hire of Lantern	4 0 10
Stationery, Postages, Carriages, etc.	2 17 3
Fire Insurance on Books, etc.	0 5 0
Honorarium to Treasurer	4 4 0
	£91 7 0
Excess of Expenditure over Income	£27 8 0

STATE OF FUNDS.

Life Members' Fund.

Balance of Fund at close of Session 1918–1919		£129 1 4
Add—Life compositions received		9 9 0
		£138 10 4
Deduct—Transferred to Income		10 16 4
Balance as at close of Session		£127 14 0

Ordinary Fund.

Balance of Fund at close of Session 1918–1919	£50 0 8	
Deduct—Decrease during Session 1919–1920	27 8 0	
Balance as at close of Session		22 12 8
Total Funds		£150 6 8

Being:—£100 5% War Stock, 1929–1947				£95	0	0
Sum in Current Account with Union Bank of Scotland, Ltd. .				27	10	1
Sum in Deposit Receipt with do.				100	0	0
				£222	10	1
Less—Accounts unpaid	£69	13	5			
Due to Treasurer	2	10	0			
				72	3	5
				As above .		£150 6 8

Note.—Subscriptions in arrear, considered recoverable: 1917–18, 15s.; 1918–19, £1, 10s.; 1919–20, £3, 15s.

EDINBURGH, 7*th December* 1920.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1919–1920, and have found them correct. I have also checked the foregoing Abstract, and find it correct.
ROBT. C. MILLAR, C.A., *Auditor.*

Mr. JOHN GARRIOCK was elected a non-Resident Fellow.

Dr. W. G. SMITH read a communication on a Vegetation Survey of the Moorfoots in which he described the various vegetation units of the district, using a large scale map and many photographs as illustrations. The survey was partly the work of the late Donald Macpherson, and had been undertaken to correlate the sheep value of the various hirsels with the different types of pasturage.

Mr. ARTHUR BENNETT communicated a paper on *Pyrola rotundifolia*, Linn., in Caithness, with notes on the genus (see p. 71), and also a note on *Vaccinium Myrtillus*, Linn., var. *pygmaeus*, Ostenfeld, f. *microphylla*, Lange (see p. 75).

Mr. H. F. TAGG exhibited some specimens of Ash twigs damaged by insect attacks.

Dr. A. W. BORTHWICK showed samples of German war-time string made from paper.

The following plants in flower were shown from the Royal Botanic Garden:—*Aberonia myosurus*, Lindl.; *Angraecum distichum*, Lindl.; *Bulbophyllum lemniscatum*, Parish; *Bulbophyllum papillosum*, J. J. Sm.; *Cirrhopetalum guttulatum*, Hook. f.; *Octomeria grandiflora*, Lindl.; *Porpax Meirax*, King et Prantl; *Stelis alba*, H. B. et K.

JANUARY 20, 1921.

W. G. SMITH, B.Sc., Ph.D., President, in the Chair.

The PRESIDENT intimated the death, on the previous day, of Dr DAVID YELLOWLEES, a non-Resident Fellow.

Mr. A. GUTHRIE SMITH read a paper on The Immigration of Weeds from the Coast in New Zealand, in which he gave some results of his observations since 1882 on the alien weed flora of his farm and surrounding country near Hawke Bay, each stage of the development of the land being marked by its particular species, and he described some of the many methods by which the alien weeds were introduced and spread over the country.

Mr. WILLIAM EVANS read a paper on Some Moss Records from St. Kilda (see p. 67).

Dr. MALCOLM WILSON exhibited specimens of Spruce Canker caused by *Dasycypha calyciformis*, Willd., the first time recorded for Britain.

The following plants in flower were shown from the Royal Botanic Garden:—*Bulbophyllum comosum*, Hemsl.: *Epidendrum polybulbon*, Sw.: *Masdevallia Schlimii*, Linden; *Maxillaria lepidota*, Lindl.; *Maxillaria Mooreana*, Rolfe; *Pleione yunnanensis*, Rolfe.

FEBRUARY 17, 1921.

JAMES FRASER, Esq., Vice-President, in the Chair.

Mr. W. W. SMITH and Mr. W. E. EVANS communicated a description of a new genus of Sterculiaceae, named *Craigia*, in honour of Dr. Wm. Craig, a past President of the Society (see p. 69). Specimens of the type species *Craigia yunnanensis* were also shown.

Dr. R. S. MACDOUGALL read a paper on Furniture Beetles, their life-history and how to fight them, in which he gave an interesting account of *Anobium domesticum* and other species which attack and destroy furniture, and showed many specimens of the damage done by them, including some of the damaged wood from Westminster Hall. He also discussed the various methods of killing the beetles and of preserving wood against their attacks.

Dr. MALCOLM WILSON exhibited specimens of *Pinus austriaca* and *P. montana* attacked by *Brunchorstia distruens*, which had been obtained near Peebles. This is the first time this fungus has been recorded in Britain.

Living plants of the following species of *Mesembryanthemum* were shown from the Royal Botanic Garden:—*M. bilobum*, Marloth; *M. Bolusii*, Hook. f.; *M. Elishae*, N. E. Br.; *M. Lesliei*, N. E. Br.; *M. Nevillei*, N. E. Br.; *M. obcordellum*, Haw.; *M. Pearsoni*, N. E. Br.; *M. pictum*, N. E. Br.; *M. pseudotruncatellum*, A. Berger; *M. testiculatum*, Jacq.; *M. truncatellum*, Haw.

MARCH 17, 1921.

W. G. SMITH, B.Sc., Ph.D., President, in the Chair.

Colonel H. H. JOHNSTON read two papers, Additions to the Flora of Orkney as recorded in Watson's Topographical Botany, 2nd Ed. (see p. 51), and Notes on Some Rare or Interesting Orkney Plants. These he illustrated by a large number of specimens collected by himself in Orkney.

Dr. W. G. SMITH exhibited a number of potatoes raised from seed.

The following plants in flower were shown from the Royal Botanic Garden:—*Corydalis Alleni*, Hort.; *Daphne Blagayana*, Freyer; *Daphne pontica*, Linn.; *Morisia hypogaea*, J. Gay; *Oresitrophe rupifraga*, Bunge; *Prostanthera rotundifolia*, R. Br.; *Shortia uniflora*, Maxim.; *Vaccinium hirsutum*, Buckl.; *Wulfenia cordata*, Greene.

APRIL 21, 1921.

W. G. SMITH, B.Sc., Ph.D., President, in the Chair.

Mr. JOHN SUTHERLAND was elected a Resident Fellow.

Dr. J. MACLEAN THOMPSON was elected a non-Resident Fellow.

The PRESIDENT announced the death, on 11th March, of Mr. J. R. DRUMMOND, a non-Resident Fellow.

Mr. GLODE GUYER read a paper on the Cultivation of Medicinal Plants in Scotland—Past and Present, in which he detailed the history of the foundation of the Physic Gardens in Edinburgh, by Robert Sibbald and Andrew Balfour, and their development into the present Royal Botanic Garden. He also described the garden commenced by Duncan, Flockhart & Co. at Warriston, and many of the medicinal plants grown there. The paper was illustrated by a large number of lantern slides, by a series of enlarged photographs, and by a number of the herbs both fresh and in the dried state.

MAY 19, 1921.

T. CUTHBERT DAY, Esq., in the Chair.

Mr. J. MONTAGU F. DRUMMOND was elected a Resident Fellow.

Miss GERTRUDE JARDINE was elected an Ordinary Member.

The CHAIRMAN announced the death of Dr. HENRY BARNES, a non-Resident Fellow.

Mr. WILLIAM EVANS read a paper on Scottish Humble Bees, in which he gave an account of the species of *Bombus* and *Psithyrus* which occur in Scotland, and suggested as an interesting study the noting of the species of bee which visit introduced plants. He also exhibited specimens of the various species.

JUNE 16, 1921.

JAMES WHYTOCK, Esq., in the Chair.

Mr. JAMES TEMPLETON read a paper on the Effect of late Frost on Wood of *Acer*, and showed sections of a tree recently cut which had fractured on drying, the flaws being evidently due to the exceptional frost of 1897.

Dr. MALCOLM WILSON exhibited specimens of Douglas Fir on which wounds caused by *Phomopsis* had begun to heal, the cambium having been killed on a part only of the circumference.

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PROCEEDINGS

OF THE

BOTANICAL SOCIETY OF EDINBURGH.

SESSION LXXXVI

OCTOBER 20, 1921.

W. G. SMITH, B.Sc., Ph.D., President, in the Chair.

The following Office-Bearers were elected for Session 1921–1922:—

PRESIDENT.

W. G. SMITH, B.Sc., Ph.D.

VICE-PRESIDENTS.

T. BENNET CLARK, C.A.
R. STEWART MACDOUGALL, M.A., D.Sc.
J. RUTHERFORD HILL, Esq.
MALCOLM WILSON, D.Sc., F.L.S., F.R.S.E.

COUNCILLORS.

A. W. BORTHWICK, O.B.E., D.Sc.
JAMES FRASER, Esq.
SYMINGTON GRIEVE, Esq.
ANDREW HOWISON, M.A., B.Sc.
Col. H. H. JOHNSTON, C.B., C.B.E., F.L.S.
MRS. JOHN LAW.
ISA MARTIN, M.A.
Sir JOHN STIRLING MAXWELL, Bart.
R. A. ROBERTSON, M.A., B.Sc.
JAMES WHYTOCK, Esq.

Honorary Secretary—W. W. SMITH, M.A., F.R.S.E.
Foreign Secretary—Very Rev. D. PAUL, M.A., D.D., LL.D.
Treasurer—ANDREW MASON, Esq., c/o RICHARD BROWN & Co., C.A.
Assistant-Secretary—J. T. JOHNSTONE, M.A., B.Sc.
Artist—Professor FRANCIS M. CAIRD, M.B., C.M., F.R.C.S.E.
Auditor—ROBERT C. MILLAR, C.A.

LOCAL SECRETARIES.

Aberdeen—Professor W. G. Craib, M.A.
Calcutta—Professor S. C. Mahalanobis, B.Sc., F.R.S.E., F.R.M.S., Presidency College.
Cambridge—Arthur Evans, M.A.
Croydon—A. Bennett, A.L.S.
East Liss, Hants—James Sykes Gamble, M.A., C.I.E., F.R.S.
Glasgow—Professor F. O. Bower, Sc.D., F.R.S., F.L.S.
London—William Carruthers, F.R.S., F.L.S.
„ J. F. Duthie, B.A., F.L.S.
„ E. M. Holmes, F.L.S., F.R.H.S.
„ Lieut.-Col. Sir David Prain, M.D., C.I.E., F.R.S., F.L.S., Royal Botanic Gardens, Kew.
Philadelphia, U.S.A.—Professor J. M. Macfarlane, D.Sc., F.R.S.E.
St. Andrews—Professor M'Intosh, M.D., LL.D., F.R.S.E.
„ Robert A. Robertson, M.A., B.Sc.
Toronto, Ontario—The Hon. W. R. Riddell, B.Sc., B.A., LL.D.

Miss Isabella M. King was elected a Resident Fellow.

Dr. W. G. Smith delivered his Presidential Address (see p. 77).

Mr. James Fraser exhibited specimens of *Sieglingia decumbens*, Bernh., showing basal florets which produced seed. A number of points were raised in the subsequent discussion, such as the value of these florets to the plant, which showed the need for further observation and research.

Dr. Malcolm Wilson exhibited specimens of Potato attacked by *Armillaria mellea* (*Vahl*) *Quel.*, collected in the neighbourhood of Edinburgh. This fungus has not been previously described as a potato disease in Europe, although recorded from Australia and Japan.

A number of plants in flower were shown from the Royal Botanic Garden.

NOVEMBER 17, 1921.

W. G. SMITH, B.Sc., Ph.D., President, in the Chair.

Miss ESME DALMAHOY was elected an Ordinary Member.

Miss MARION WALKER, Miss JANET WATT, Dr. R. J. D. GRAHAM, Mr. JOHN F. V. PHILLIPS, and Mr. ERNEST V. LAING were elected Resident Fellows.

Mr. T. BENNET CLARK read a note on a Seedling of *Cytisus Adami*, Poit. (see p. 84), and exhibited specimens of the leaves and photographs of the seedling.

Mr. W. E. EVANS communicated a paper by Dr. E. J. SALISBURY on *Salicornia dolichostachya*, Moss, in Scotland (see p. 87).

Mr. W. E. EVANS exhibited a series of specimens of *Salicornia* from the Lothians to illustrate the preceding paper.

Dr. W. G. SMITH read a paper on *Spartina Townsendii* in the Forth, the plant having been introduced between Kincardine-on-Forth and Carriden in 1914. It has flowered there but not fruited, and it is not spreading.

The Hon. W. R. RIDDELL communicated a paper on a Preacher-Physician's Pharmacopœia, dealing with *Steward's Healing Art*, published at Saco, Maine, in 1827.

On behalf of Mr. ARTHUR BENNETT a paper was read, Notes on Pinguicula (see p. 87).

The following plants in flower were shown from the Royal Botanic Garden:—*Anthocercis viscosa*, R. Br.; *Coleus Rehneltianus*, Hort.; *Cuscuta reflexa*, Roxb.; *Nemophila integrifolia*, Abrams; and *Rhododendron linearifolium*, Sieb. et Zucc.

DECEMBER 15, 1921.

W. G. SMITH, B.Sc., Ph.D., President, in the Chair.

The TREASURER, Mr. ANDREW MASON, submitted the following Statement of Accounts for Session 1920–1921 :—

INCOME.

Annual Subscriptions for 1920–1921	£29	5	0
Do. Arrears	3	0	0
Transfer from Life Members' Fund	12	3	7
Transactions sold	4	5	0
Interest on Funds Invested and in Bank	9	3	4
Subscriptions to Illustration Fund	2	5	0
	£60	1	11

EXPENDITURE.

Printing Notices for Meetings, etc.	£23	14	0
Rooms for Meetings and Tea	11	10	0
Stationery, Postages, Carriages, etc.	5	6	1
Fire Insurance on Books, etc.	0	5	0
Honorarium to Treasurer	3	3	0
	£43	18	1
Excess of Income over Expenditure	£16	3	10

STATE OF FUNDS.

Life Members' Fund.

Balance of Fund at close of Session 1919–1920	£127	14	0
Add—Life compositions received	29	8	0
	£157	2	0
Deduct—Transferred to Income	12	3	7
Balance as at close of Session	£144	18	5

Ordinary Fund.

Balance of Fund at close of Session 1919–1920	£22	12	8		
Add—Increase during Session 1920–1921	16	3	10		
Balance as at close of Session, subject to expense of printing *Transactions*				38	16	6
Total Funds				£183	14	11

Being:—£100 5% War Stock, 1929–1947		£95 0 0	
Sum in Current Account with Union Bank of Scotland, Ltd. .		11 7 5	
Sum in Deposit Receipt with do.		100 0 0	
		£206 7 5	
Less—Account unpaid .	£20 17 6		
Subscriptions received in advance	1 15 0		
		22 12 6	
		As above .	£183 14 11

Note.—Subscriptions in arrear, considered recoverable: 1919–20, 15s.; 1920–21, £3, 15s.

EDINBURGH, *7th December* 1921.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1920–1921, and have found them correct. I have also checked the foregoing Abstract, and find it correct.
ROBT. C. MILLAR, C.A., *Auditor.*

Mr. CHARLES S. S. JOHNSTON and Mr. R. GLODE GUYER were elected Resident Fellows.

Dr. W. BURNS was elected a non-Resident Fellow.

Dr. W BURNS read a paper on the Ecology of Western India, treating mainly of the desert flora and especially with the presence of salt and its effect on vegetation, with sand and sand-binders, with the vegetation in canals and the conditions favouring it, and also with the population of desert areas. The paper was illustrated by a series of lantern slides.

Dr. W. BALFOUR GOURLAY exhibited some specimens from a volcano in Java and from the Grand Canyon in California.

JANUARY 19, 1922.

W. G. SMITH, B.Sc., Ph.D., President, in the Chair.

Rev. J. R. S. WILSON and Miss HELEN I. ALLAN GRAY were elected Resident Fellows.

Mr. W. W. SMITH and Professor JAMES SMALL communicated the description of a new Genus of *Compositae*, *Formania* (see p. 91), and exhibited a specimen of *Formania mekongensis*, the type of the genus.

Mr. E. M. Buchanan exhibited a large series of photographs from the Burmese forests and from the Andaman Islands and made interesting remarks on the forest flora.

The following plants in flower were shown from the Royal Botanic Garden:—*Acacia Jonesii*, F. Muell. et J. H. Maiden; *Crassula perfoliata*, Linn.; *Crassula recurva*, N. E. Br.; *Daphne Genkwa*, Sieb. et Zucc.; *Osteomeles anthyllidifolia*, Lindl.; *Pelargonium flavum*, Soland.; *Phylica paniculata*, Willd.

FEBRUARY 16, 1922.

W. G. Smith, B.Sc., Ph.D., President, in the Chair.

The President announced the death on 3rd February of Dr. William Craig, who had been a Resident Fellow since 1866. He had held the office of President from 1887–1889 and that of Hon. Secretary from 1900–1912, and had contributed many papers to the Transactions of the Society.

On behalf of Mr. G. F. Scott Elliot there was read a note on the Occurrence of *Alchemilla conjuncta*, Bab., in Dumfriesshire (see p. 97).

Mrs. C. Norman Kemp read a paper, Notes on the Application of X-rays to Botanical Research, in which she gave a summary of the work already done both where their power of affecting photographic plates were taken advantage of and also where their power of affecting living tissue was used, and possible applications to botanical research were indicated. The paper was illustrated by a number of lantern slides.

MARCH 16, 1922.

J. Rutherford Hill, Esq., Vice-President, in the Chair.

Mr. David Moncur was elected a Resident Fellow.

The Chairman announced the death on 23rd February of Mr. J. F. Duthie, who had been a non-Resident Fellow since 1869.

Dr. Malcolm Wilson read a paper on the Occurrence of Perithecia of the Oak Mildew, in which he described the morphology and distribution of the oak mildew, *Microsphaera alni*, var. *extensa*, Salm. The occurrence of perithecia on *Quercus conferta* from Macedonia was recorded.

Mr. J. A. Alexander communicated a paper on Palms and their Produce, which was illustrated by a series of photographs.

Mr. W. E. Evans exhibited on behalf of Mr. James Fraser and himself some alien plants from the Lothians—being *Ranunculi* of the section *Echinella*, and explained that this was the first of what they hoped would be a considerable series of local aliens which would form the basis of a paper on the subject later.

Mr. W. E. Evans exhibited *Centaurea obscura*, Jord., *forma*, from the Pentlands, collected by Miss Roper in September 1921.

The following plants in flower were shown from the Royal Botanic Garden:—*Coelogyne Delavayi*, Rolfe; *C. yunnanensis*, Rolfe; *Hesperochiron californicus*, S. Wats.; *Oresitrophe rupifraga*, Bunge; *Primula Dubernardiana*, G. Forrest; *P. Fortunei*, Vatke; *P. Knuthiana*, Pax; and *Rhododendron spinuliferum*, Franch.

APRIL 20, 1922.

James Whytock, Esq., in the Chair.

Colonel H. H. Johnston communicated a paper on Additions to the Flora of Orkney, as recorded in Watson's Topographical Botany, 2nd ed., 1883 (see p. 98). This was illustrated by a large number of mounted specimens of the more noteworthy additions.

Mr. J. R. Matthews exhibited the hybrid *Potamogeton venustus* from the River Earn.

A number of plants in flower were shown from the Royal Botanic Garden.

MAY 18, 1922.

W. G. SMITH, B.Sc., Ph.D., President, in the Chair.

Mr. L. B. STEWART read a note on Juvenile Characters in Root and Stem Cuttings of *Acanthus montanus* (see p. 117).

Dr. A. W. BORTHWICK communicated a note by Lieut.-Col. STEUART FOTHRINGHAM on Lobing of Rhododendron Leaves, describing various abnormalities of leaves, of which he also exhibited specimens.

Mr. WILLIAM EVANS read a note on the occurrence of *Anthoceros* in Scotland, giving a new record for W. Lothian of *A. punctatus*, Linn., of which he exhibited a specimen.

JUNE 15, 1922.

W. G. SMITH, B.Sc., Ph.D., President, in the Chair.

Mr. J. R. SIMPSON was elected a Resident Fellow.

The PRESIDENT read an obituary notice of WILLIAM CARRUTHERS, the oldest member of the Society, who died on 1st June (see p. 118).

Mr. A. D. RICHARDSON exhibited specimens of *Arabis albida, fl. pl.*, with a peculiar variation in the doubling.

Dr. MALCOLM WILSON exhibited injured seedlings of Scots Pine and Douglas Fir where the injury consisted of the crushing of a ring of cortex and bark a few inches above ground level, probably caused by the use of a planting frame. This resulted in a swelling by abnormal growth above the injury and a downward development of callus tissue. Such plants ultimately die.

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SESSION LXXXVII

OCTOBER 19, 1922.

W. G. Smith, B.Sc., Ph.D., President, in the Chair.

The following Office-Bearers were elected for Session 1922–1923:—

PRESIDENT.

Professor W. Wright Smith, M.A., F.L.S., F.R.S.E.

VICE-PRESIDENTS.

T. Bennet Clark, C.A.
James Fraser, Esq.
Symington Grieve, Esq.
R. Stewart MacDougall, M.A., D.Sc.

COUNCILLORS.

A. W. Borthwick, O.B.E., D.Sc.
J. Rutherford Hill, Esq.
Andrew Howison, M.A., B.Sc.
Col. H. H. Johnston, C.B., C.B.E., F.L.S.
Mrs C. Norman Kemp, M.A., D.Sc.
W. G. Smith, B.Sc., Ph.D.
Sir John Stirling Maxwell, Bart.
James Whytock, Esq.
Malcolm Wilson, D.Sc., F.L.S., F.R.S.E.
William Young, Esq.

Honorary Secretary—J. R. Matthews, M.A., F.L.S.
Foreign Secretary—Very Rev. D. Paul, M.A., D.D., LL.D.
Treasurer—Andrew Mason, Esq., c/o Richard Brown & Co., C.A.
Assistant-Secretary—J. T. Johnstone, M.A., B.Sc.
Artist—Professor Francis M. Caird, M.B., C.M., F.R.C.S.E.
Auditor—Robert C. Millar, C.A.

LOCAL SECRETARIES.

Aberdeen—Professor W. G. Craib, M.A.
Calcutta—Professor S. C. Mahalanobis, B.Sc., F.R.S.E., F.R.M.S., Presidency College.
Cambridge—Arthur Evans, Sc.D.
Croydon—A. Bennett, A.L.S.
East Liss, Hants—James Sykes Gamble, M.A., C.I.E., F.R.S.
Glasgow—Professor F. O. Bower, Sc.D., F.R.S., F.L.S.
London—J. F. Duthie, B.A., F.L.S.
„ E. M. Holmes, F.L.S., F.R.H.S.
„ Lieut.-Col. Sir David Prain, M.D., C.I.E., F.R.S., F.L.S.
Philadelphia, U.S.A.—Professor J. M. Macfarlane, D.Sc., F.R.S.E.
St. Andrews—Professor M'Intosh, M.D., LL.D., F.R.S.E.
„ Robert A. Robertson, M.A., B.Sc.
Toronto, Ontario—The Hon. W. R. Riddell, B.Sc., B.A., LL.D.

Mr. David King was elected a Resident Fellow.

Dr. R. J. D. Graham read a paper on Iraq Arabi, which was well illustrated by a fine series of lantern slides.

Dr. W. G. Smith exhibited specimens of *Mucilago spongiosa* occurring on Strawberry.

Dr. Malcolm Wilson exhibited specimens of *Cantharellus carbonarius* (A. et S.) Fr., collected near Edinburgh. Although this species is described as common in England, this appears to be the first record for Scotland. It was found on burnt ground which was intermixed with pieces of charcoal, which is described as its usual habitat and accounts for its specific name. The species, which shows the usual characters of *Cantharellus*, is characterised by possessing well-developed root-like mycelial strands which pass off from the base of the stem. On account of these structures the species is also known as *Cantharellus radicosus* (B. et Br.) Fr.

Mr. H. F. Tagg exhibited specimens from Jersey of galls on Acorn Cups caused by *Cynips quercus-calicis*.

NOVEMBER 16, 1922.

Professor W. WRIGHT SMITH, M.A., F.L.S., F.R.S.E., President, in the Chair.

Miss AGNES CHALMERS, Mrs. DOUIE URQUHART, and Mr. E. M. BUCHANAN were elected Resident Fellows.

Mr. DAVID M'CALL was elected a non-Resident Fellow.

Miss H. C. ABERNETHY, Miss C. C. BURT, Miss A. N. CUMMING, Miss E. M. HENDERSON, Miss M. M. B. KNAGG, Miss K. MASSEY, and Miss M. J. F. WILSON were elected Ordinary Members.

The PRESIDENT read an obituary notice of WILLIAM EVANS, an Associate of the Society since 1871 (see p. 189).

Mr. IAN W. SEATON read a paper on the Seedling Structure of *Salix pentandra* (see p. 161).

Dr. MALCOLM WILSON read a paper on *Puccinia mirabilissima*, Peck (see p. 164).

Mr. J. R. MATTHEWS exhibited *Azolla filiculoides*, Lam., from Norfolk, and *Tillaea aquatica*, Linn., from Yorkshire.

Mr. J. RUTHERFORD HILL exhibited specimens of Calabar Beans and of the drugs made from them.

The following plants in flower were shown from the Royal Botanic Garden :—*Cirrhopetalum Makoyanum*, Reichb. f.; *Coelogyne* (*Pleione*) *maculata*, Lindl.; *Dorstenia yumbuyaensis*, De Wild.; *Hamelia patens*, Jacq.; *Masdevallia Laucheana*, Hort. Sander.; *Pinguicula caudata*, Schl.; *Pleurothallis astrophora*, Reichb. f.; *Sempervivum tabulaeforme*, Haw.; *Stenoglottis longifolia*, Hook. f.

DECEMBER 21, 1922.

Professor W. WRIGHT SMITH, M.A., F.L.S., F.R.S.E., President, in the Chair.

The TREASURER, Mr. ANDREW MASON, submitted the following Statement of Accounts for Session 1921–1922:—

INCOME.

Annual Subscriptions for 1921–1922	£32	10	0
Do. Arrears	2	5	0
Transfer from Life Members' Fund	14	10	10
Transactions sold	6	1	6
Interest on Funds Invested and in Bank	7	19	2
Subscriptions to Publications Fund	18	18	0
	£82	4	6

EXPENDITURE.

Printing *Transactions* for Session 1920–1921	£27	6	9
Printing Notices for Meetings, etc.	22	6	0
Rooms for Meetings and Tea	11	2	0
Stationery, Postages, Carriages, etc.	3	10	8
Fire Insurance on Books, etc.	0	5	0
Honorarium to Treasurer	3	3	0
	£67	13	5
Excess of Income over Expenditure	£14	11	1

STATE OF FUNDS.

Life Members' Fund.

Balance of Fund at close of Session 1920–1921	£144	18	5
Add—Life compositions received	47	5	0
	£192	3	5
Deduct—Transferred to Income	14	10	10
Balance as at close of Session	£177	12	7

Ordinary Fund.

Balance of Fund at close of Session 1920–1921			£38	16	6	
Add—Increase during Session 1921–1922			14	11	1	
Balance as at close of Session, subject to expense of printing *Transactions*						53 7 7
Total Funds						£231 0 2

Being :—£100 5% War Stock, 1929–1947	£95	0	0	
Sum in Current Account with Union Bank of Scotland, Ltd. .	12	0	2	
Sum in Deposit Receipt with do.	125	0	0	
	£232	0	2	
Less—Subscriptions received in advance	1	0	0	
As above .				£231 0 2

Note.—Subscriptions in arrear, considered recoverable : 1920–21, £1 10s. ; 1921–22, £4, 10s.

EDINBURGH, 6*th December* 1922.—I hereby certify that I have audited the Accounts of the Treasurer of the Botanical Society of Edinburgh for Session 1921–1922, and have found them correct. I have also checked the foregoing Abstract, and find it correct.
ROBT. C. MILLAR, C.A., *Auditor.*

Miss EDITH PHILIP SMITH, Mr. GEORGE CROSBIE TAYLOR, Mr. IAN W. SEATON, Mr. HERBERT M. LEWIS, and Miss DOROTHY G. WILSON were elected Resident Fellows.

The PRESIDENT read an obituary notice of Sir ISAAC BAYLEY BALFOUR (see p. 192.)

Miss D. G. WILSON read a paper, Observations on the Leaf of *Senecio gonocladus* (see p. 167).

Professor W. WRIGHT SMITH read a paper, Notes on Chinese Lilies (see p. 122).

Dr. R. S. MACDOUGALL exhibited specimens of *Eriophyes fraxini* on the Ash, and of *Enarmonia diniana* on *Pinus sylvestris.*

Mr. J. L. S. SMITH exhibited specimens of Cone Disease of *Pinus sylvestris*, sometimes called Multiple-coning.

Professor W. WRIGHT SMITH exhibited specimens of *Osmanthus Forrestii*, Rehder, a new species from Yunnan.

Two paintings of the old Royal Botanic Garden, Leith Walk, were exhibited.

The following plants in flower were shown from the Royal Botanic Garden :—*Arctostaphylos Manzanita*, Parry ; *Cirrhopetalum Micholtzii*, Rolfe ; *Crassula impressa*, N. E. Br. ; *Euadenia eminens*, Hook. f. ; *Lardizabala biternata*, Ruiz et Pav. ; *Lycaste macrophylla Measuresiana ; Masdevallia poly-*

sticta, Reichb. f.; *Mesembryanthemum Elishae*, N. E. Br.; *Odontoglossum crispum*, var.; and *Oncidium cucullatum*, Lindl.

JANUARY 18, 1923.

SYMINGTON GRIEVE, Esq., Vice-President, in the Chair.

Mr. HARRY G. YOUNGER was elected a Resident Fellow.

The Hon. BERNARD F. ROLLO was elected a non-Resident Fellow.

Mr. ROBERT M. ADAM read a paper on Mingulay, an Outer Isle of the Hebrides, in which he described the flora of the island and its changes during the last few years brought about principally by its being deserted by its former inhabitants some ten years ago. He also showed a large series of lantern slides illustrating his paper, giving also some studies of bird life on the western cliffs of the island.

FEBRUARY 15, 1923.

Professor W. WRIGHT SMITH, M.A., F.L.S., F.R.S.E., President, in the Chair.

Mr. E. H. M. COX was elected a non-Resident Fellow.

The PRESIDENT announced the death of M. GASTON BONNIER, who had been an Hon. Foreign Fellow since June 1902.

Miss EDITH PHILIP SMITH read a paper on Plant Respiration as affected by anæsthetics.

Miss HELEN I. ALLAN GRAY communicated a paper on Seed Treatment and Germination in Conifers.

Dr. MALCOLM WILSON exhibited specimens of *Aecidium Otites*, Schlechtd. on *Silene densiflora*, Urv., collected in Macedonia. The aecidia are associated with sori of unicellular teleutospores, which indicates that the fungus is a species of *Uromyces*.

Mr. J. R. MATTHEWS read a paper, Notes on Scottish Plants (see p. 170), and exhibited specimens of *Potamogeton* and *Callitriche*.

Miss Elsie Cadman exhibited specimens of *Actinomyces Scabies*, the cause of common Potato Scab, and gave some account of the disease.

The following plants in flower were shown from the Royal Botanic Garden :—*Lathraea clandestina*, Linn. ; *Rhododendron acuminatum*, Hook. f. ; *R. argenteum*, Hook. f. ; *R. barbatum*, Wall. ; *R. irroratum*, Franch. ; *R. moupinense*, Franch. ; *R. nobleanum* (*arboreum* × *caucasicum*) ; *R. nobleanum album* (*arboreum album* × *caucasicum*) ; and *R. praecox* (*dahuricum* × *ciliatum*).

MARCH 15, 1923.

Professor W. Wright Smith, M.A., F.L.S., F.R.S.E., President, in the Chair.

Mr. John H. Gray was elected a Resident Fellow.

Mr. Ernest V. Laing read a paper on Mycorhiza and Tree Growth in Peat, which he illustrated by lantern slides.

Dr. R. J. D. Graham exhibited specimens of *Crocus vernus* showing pull roots.

A portrait of Linnaeus engraved from a copy of Hoffman's painting was exhibited.

The following plants in flower were shown from the Royal Botanic Garden :—*Aerides vandarum*, Reichb. f. ; *Vanda teres*, Lindl. and *Aerio-vanda Mundayi*, Hort. Edin., a hybrid between *Aerides vandarum* and *Vanda teres* ; *Primula Allioni*, Loisel. ; *P. darialica*, Rupr. ; *P. Fortunei*, Vatke ; *P. frondosa*, Janka ; *P. obconica alba* ; *P. philoresia*, Balf. f. ; *Saxifraga Boydii*, Hort. Dewar ; *S. Burseriana*, var. ; *S. Irvingi*, Hort. ; *S. latina*, Hayek ; *S. Rudolphiana*, Reichb. f. ; and *Soldanella pusilla*, Baumg.

APRIL 19, 1923.

Professor W. Wright Smith, M.A., F.L.S., F.R.S.E., President, in the Chair.

Col. H. H. Johnston read a paper, Additions to the Flora of Orkney as recorded in Watson's Topographical Botany, 2nd ed., 1883 (see p. 174), and exhibited a number of interesting illustrative specimens collected by himself.

Dr. J. M. Dalziel exhibited specimens of *Barteria nigritana*, a Nigerian Myrmecophyte.

Mr. J. Rutherford Hill exhibited a piece of Carnauba Wax which had been found floating in the sea on the Ayrshire Coast.

The following species of Primula in flower were shown from the Royal Botanic Garden :—*P. conspersa*, Balf. f. et Purdom ; *P. deflexa*, Duthie ; *P. fasciculata*, Balf. f. et Ward ; *P. Forrestii*, Balf. f. ; *P. Giraldiana*, Pax. ; *P. involucrata*, Wall. ; *P. Maclareni*, Balf. f. ; *P. Marven* (*marginata* × *venusta*) ; *P. Menziesiana*, Balf. f. et W. W. Sm. ; *P. redolens*, Balf. f. et Ward ; *P. rupicola*, Balf. f. et Forrest ; *P. saxatilis*, Kom. ; *P. Sieboldii*, E. Morren ; *P. sino-Listeri*, Balf. f. ; and *P. Werringtonensis*, Hort. Wallace.

MAY 17, 1923.

Professor W. Wright Smith, M.A., F.L.S., F.R.S.E., President, in the Chair.

Mr. R. A. Taylor was elected a non-Resident Fellow.

Dr. R. J. D. Graham and Mr. L. B. Stewart communicated a paper on the Vegetative Propagation of *Haemanthus hirsutus*, Baker (see p. 183).

Mr. M. Y. Orr exhibited specimens of abnormal flowers of Wallflower.

JUNE 21, 1923.

Professor W. Wright Smith, M.A., F.L.S., F.R.S.E., President, in the Chair.

Dr. G. C. Druce, Dr. R. Lloyd Praeger, and Dr. A. B. Rendle were elected Hon. British Fellows.

Professor D. H. Campbell, Professor R. Chodat, Professor J. M. Coulter, Professor Seittsiro Ikeno, Professor Henri Lecomte, Dr. J. P. Lotsy, Professor Jean Massart, Dr. D. T. MacDougall, Dr. C. H. Ostenfeld, Professor W. J. V. Osterhout, Professor Roland Thaxter, Professor J. F. N. Wille, and Mr. E. H. Wilson were elected Hon. Foreign Fellows.

Miss Elsie Cadman exhibited specimens, microscopic slides, and photographs, showing various stages in the life-history of *Reticularia Lycoperdon*, Bull., and gave some account of its life-history.

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